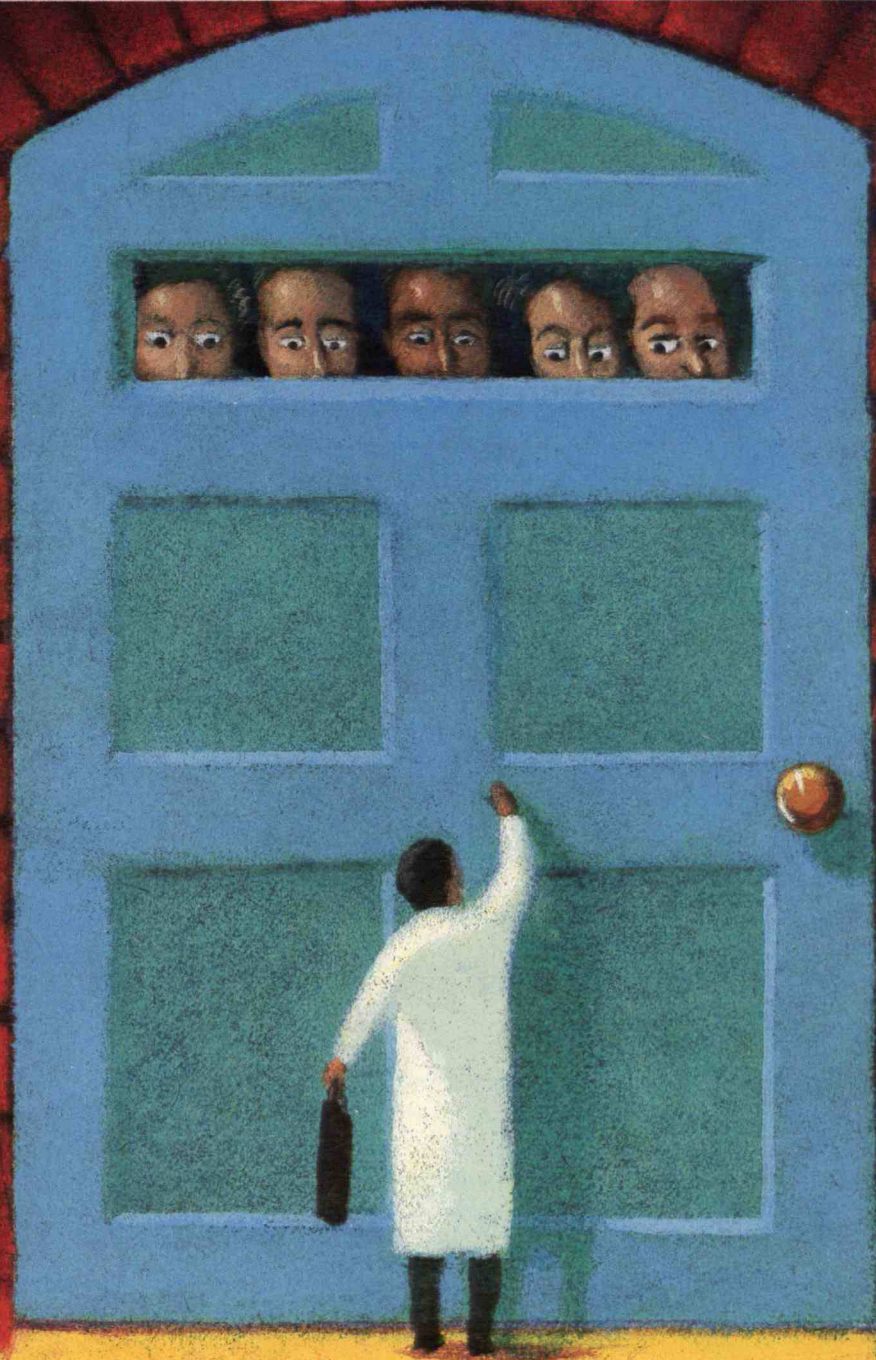


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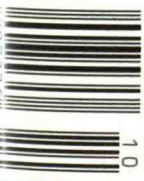
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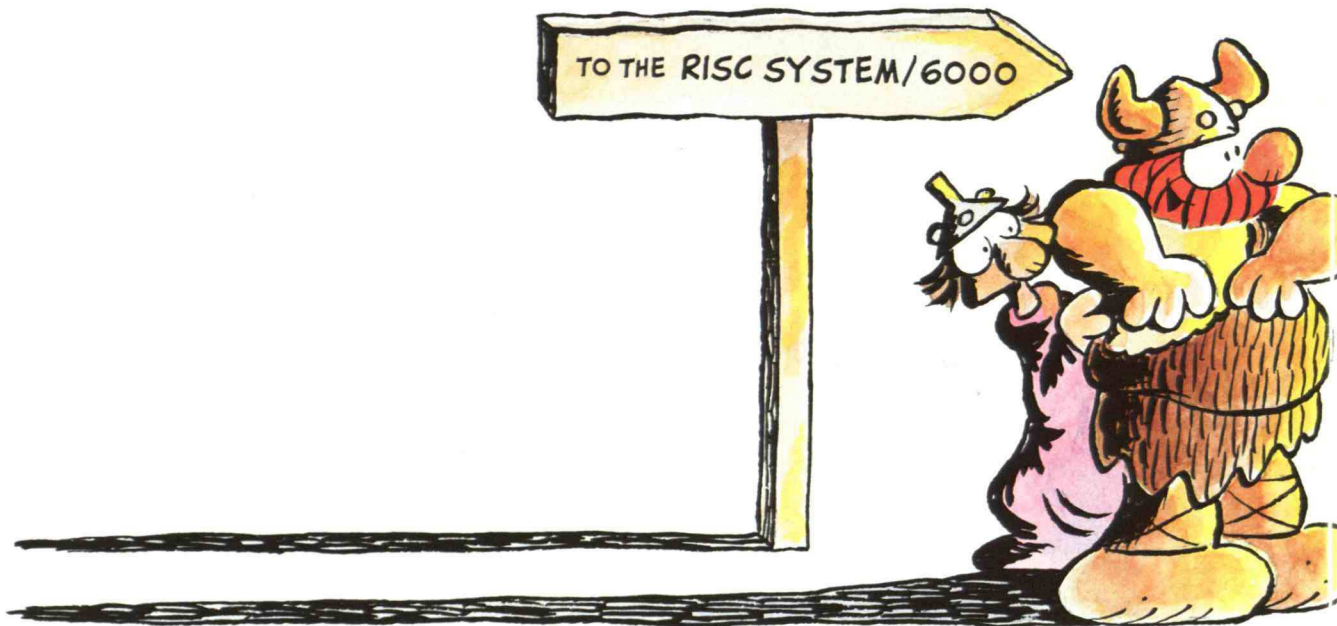
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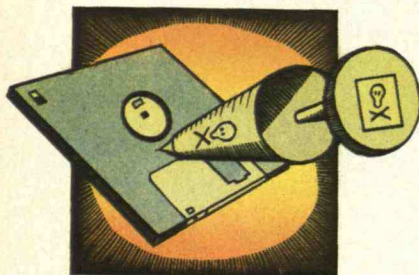
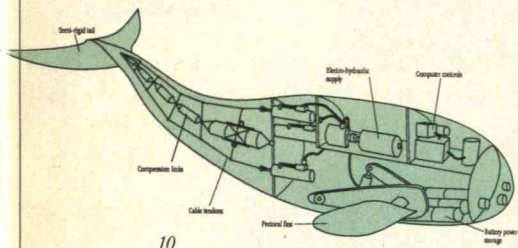
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FirstLine

Changing of the Guard

If you are a journalist or magazine buff, you will have noted that *Technology Review's* masthead lists no editor-in-chief for this issue. Jonathan Schlefer, our valued editor, has decided to write a book and resume graduate study. He has brought immense strengths to the magazine in the nine years he has devoted to it. Those strengths have fostered the *Review's* continued growth in both circulation and stature. Editors are the soul of a magazine; publishers exist principally to nourish that soul. Jonathan has been a force for the magazine's sustained intellectual integrity. We wish him well and hope he continues to contribute to the *Review* as a writer.

It gives me great pleasure to announce that with the next issue we will welcome a new editor, Steven J. Marcus. Steve holds a PhD in engineering and has been an accomplished and widely read journalist for the past 20 years. He is an old friend of *Technology Review*, having served as our managing editor during the early 1980s. Since leaving the *Review*, Steve has been a technology reporter for the *New York Times*, executive editor of *High Technology*, and, most recently, editor of *Issues in Science and Technology*. Steve brings a keen awareness of the need for a broad understanding of technology and science as well as a commitment to exploring their intimate connection with the larger fabric of society. Steve's success at *Issues* is the most recent testament to this commitment.

For the two and a half months between Jonathan's departure and the arrival of a new editor, *Technology*



Steve Marcus, Sandra Hackman.

Review has been most ably edited by managing editor Sandra Hackman and the balance of the staff. Sandra deserves both praise and thanks from all of us for her willingness to do double duty and lead the magazine during the transition. She is a long-time staff member who has grown with the *Review* through various editorial chairs, and we anticipate continued benefits from her managing editorship.

Technology Review will reach a milestone later this decade that is fairly rare in the annals of magazine journalism: we will celebrate our centennial year of publication. As we approach this anniversary we expect to continue to strengthen our significant role in exploring new technologies, the use of existing technologies, and their impact upon all of us.

No human endeavor has escaped this impact. The *Review's* challenge is to illuminate the debate about various technologies and help set priorities among them. We look forward to sharing this exploration with you under our new leadership.

WILLIAM J. HECHT

TechnologyReview

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Letters

REACTIONS TO REACTORS

Contrary to what P.J. Skerrett asserts in "Will the Public Say Yes to Nukes?" (*MIT Reporter*, TR April 1991), the gap between nuclear power's opponents and advocates cannot be "summed up in their differing views on the Three Mile Island accident." Leaders of groups like Greenpeace have shown little interest in whether nuclear power is safe. Nor do they seem especially interested in how radioactive waste can be disposed of safely. They do, however, know which issues play well to a skeptical public. Their objective is to fight nuclear power and get popular acclaim for doing it. I hold no hope that activist anti-nuclear groups can be brought into a consensus. And besides, consensus hardly means 100 percent agreement on anything anyway.

In 1976 Dr. Alvin Weinberg held a symposium whose aim was to seek consensus on the requirements for accepting a "second nuclear era." He invited Tom Cochran of the Natural Resources Defense Council and Dean Abrahamson, who was then advising the National Council of Churches on how to stop reprocessing and the breeder reactor. However, both said their position was that there should be no nuclear power. They would not accept Weinberg's hypothetical second era even for the purpose of discussion.

As to the proposal Steven Sholly of the Union of Concerned Scientists has made for citizen input into reactor design, I once challenged NRC commissioner Peter Bradford to cite any examples of activist groups that had contributed something original, innovative, or of substantial net benefit to reactor safety. His response listed 15 incidents, but none of them met those basic criteria.

Another article in the same issue of the magazine, "Rotten at the Core," in which Lawrence Lidsky reviews two books about Chernobyl, also has its problems, even though it is accurate, incisive, and well written. Regrettably, Lidsky is using *Technology Review* as a vehicle for his personal vendetta against

light-water reactors. He talks down defense-in-depth—the multiple, redundant, interconnected systems to reduce the probability of total failure—but the weakness of his case is that defense-in-depth works. It is a sound and effective basis for safety design. Chernobyl did not have defense-in-depth, and that was one of the reasons Western engineers rejected reactors of this kind a couple of decades ago. Equating today's commercial power reactors with Chernobyl is indefensible.

The "new generation of reactors" Lidsky has conceived is not even a design yet, and a detailed risk analysis would likely reveal that they are comparable in terms of actual safety to today's operating plants. One drawback is that to meet heat-dissipation criteria, the new plants would have to be very small, and therefore they have uncertain market potential. Even DOE's modular high-temperature gas-cooled reactor has twice the power. Ironically, the Germans completed a new gas-cooled reactor three years ago that has excellent safety characteristics, but it was shut down by regional political opposition.

There is no such thing as an "inherently safe reactor." Lidsky is probably correct that if there were one, it might be used to challenge the safety of those already operating. But there isn't one. The debate would be healthier if Lidsky would stick to the merits of his own design, rather than attacking other designs that work.

A. DAVID ROSSIN
Los Altos Hills, Calif.

Lawrence M. Lidsky responds:

Dr. Rossin's response is another interesting demonstration of the nuclear establishment's wish to return to a simpler time when there were good guys and bad guys and when everyone deferred to the "experts." The Greens indeed were resolutely opposed to nuclear power 15 years ago, but they have learned about the burden fossil-fuel burning puts on the environment and would now like nothing better than to find a way to produce power with as little environ-

mental impact as possible. In response, the nuclear industry continues to offer a technology that has been tried and rejected by every industrialized nation that has a choice (i.e., access to fossil fuels). This hardly seems to be a rational description of a "design that works." The public has decided that the current nuclear reactor designs are simply not good enough, and they no longer believe the experts who claim otherwise.

The world will not change to accommodate the nuclear industry. The aircraft industry moved beyond the DC-3; now the nuclear industry must move beyond the light-water reactor or the benefits of nuclear power will be lost.

TRAINS AND TRIBULATIONS

"Why the U.S. Needs a Maglev System" by Richard D. Thornton (*TR April 1991*) makes a good case for investing in maglev technology. But it's worth noting that maglev is a long-term solution. It will take decades to perfect, test, and construct a nationwide system. And the many parts of our country that need relief from highway and airway congestion now should not have to wait until a maglev system is invented and comes on line.

Trains like the French Train à Grande Vitesse (TGV) have some important advantages: the technology they rely on already exists, and they are compatible with today's U.S. railroad system. Maglev requires engineers to build a whole new track from endpoint to endpoint—say, from downtown Boston to midtown Manhattan—before the system can be of use to most riders, but TGV tracks can be built incrementally and incorporate some of the infrastructure that's already there. This is especially important in dense urban areas, where it may be difficult and expensive to find a new right-of-way for a maglev system (air-rights developments will preclude median-strip maglev construction on many urban highways). The French TGV, for instance, uses older tracks on its approach to Paris and other cities.

Yes, we should invest in maglev technology, but we shouldn't use the prospect of maglev to defer developing steel-wheel, high-speed rail systems like the TGV. These conventional rail systems can be operational long before maglev will be.

CHARLES BAHNE, JR.
Cambridge, Mass.

REEXAMINING MATERIALISM

I commend you for publishing Alan Durning's view of humanity's materialistic folly ("How Much Is Enough?" *TR* May/June 1991). While I hold little hope that we can come to terms with our gluttony before we render this planet unfit for most animal and plant life, I nonetheless wish to thank you for making an effort toward sanity by sharing Mr. Durning's suggestions.

CYRUS J. STOW
Conyers, Ga.

Perhaps the most shocking place to find an anti-technology, anti-business, anti-American diatribe would be *Technology Review*. Yet this is an exact description of "How Much Is Enough?" Durning rehashes a few old hippie arguments, practices some environmental disinformation, and rounds it all out with a pseudo-religious "solution" to a problem that doesn't exist.

For example, he contends that the United States is destroying the Amazon rainforest. But the truth is that the main cause of deforestation is not First World demand for wood but Brazil's frantic effort to turn the region into the nation's breadbasket. Less than 5 percent of all destroyed Amazon biomass is exported—most is simply burned.

Durning also charges that Americans live on the backs of the Third World. Yet the Third World poor are no worse off today than they were before the advent of American prosperity. In fact, Western agricultural and medical advances have saved hundreds of millions of lives globally.

Nor has Western industry despoiled the planet, as Durning would have it.

The ravages of civilization are far outweighed by those of nature. The largest source of greenhouse gases is termite digestion (50 billion tons annually), not "the wealthiest fifth of humanity." Moreover, the sum of all pollutants expelled into the air by human beings since the start of the Industrial Revolution is a fraction of the total toxins and particulate matter expelled from just three volcanic eruptions: Krakatoa (1883), Mount Katmai (1912), and Jekla (1947).

And finally there's the statement that materialism is philosophically unsatisfying: speak for yourself, Mr. Durning. My ownership of a car, an air conditioner, and a microwave oven has made me eminently more satisfied. And by giving me much more time and comfort, those possessions have made me more productive as well. The same is true for everyone who has them. Appliances have done more to liberate American

women than feminism itself.

The United States and other First World nations prosper because our per capita productivity is so high. We consume more because we produce more. And as a matter of fact, wage-earning Americans consume less, as a percentage of what they produce, than Third World indigents. Although Durning equates the vast output of America with greed, envy, and avarice, I prefer to attribute it to innovation, discipline, and hard work. His suggestion that we adopt a diet of grains and water to ease the earth's burden is ludicrous at best.

The author tries to convince us that we are heading for ecological disaster. I say that with the earth's ability to sustain itself and our own ability to manipulate our environment, we can meet every challenge facing us today.

MIKE ASHER
Atlanta, Ga.

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THE IDEA FACTORY

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BY PEPPER WHITE

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—Edwin Diamond, former MIT professor,
columnist, *New York* magazine



PEACE-DIVIDEND WOES

I read with interest the two articles on "peace conversion" in your August/September 1991 issue ("*Building a Peacetime Economy*" by John E. Ullman and "*An Economic Transition*" by Sandra Hackman). I strongly support the diversion of money from the military to needed civilian uses. However, I believe it is naive to think that it is possible to "convert" more than a small fraction of military plants to civilian use without major disruption to all parties involved.

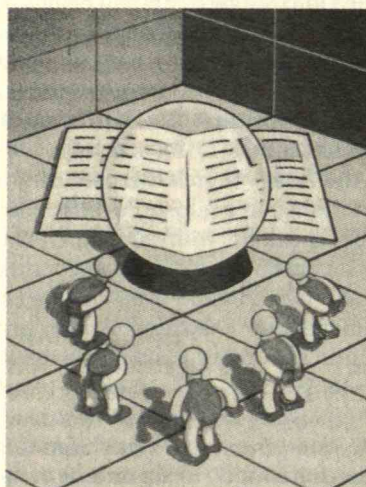
It is more likely that such conversion will proceed as conversions of ordinary businesses have proceeded—by the process of "creative destruction": when the money that supports an organization dries up, that organization closes down and the operation is shredded into its constituent people, buildings, machines, and financial assets, each of which is individually redeployed into a new use by the market. Of course, this is miserably painful for everyone involved, but it's the only conversion method that I know of.

Creative destruction in peace conversion is more likely than in ordinary businesses because manifold features of military contracting make it uncompetitive with civilian businesses. To be specific, workers are often overpaid and underworked, management and engineering are not cost-conscious, unionization is high, and last but not least, geographic location is determined more by political than cost considerations. All of these militate against simply redirecting the production of a military contractor to civilian products.

Perhaps *Technology Review* could publish an article analyzing successes and failures of peace-conversion efforts, and attempt to discern ways to make the process less painful. For example, referring to Hackman's article, why did Unisys locate its satellite tracking system production in Salt Lake City rather than St. Paul, where it had idle workers? There probably was a good reason from Unisys' point of view, but the article gives no clue what it might be. A clear-

eyed examination of the economics of conversion would be far more useful than a repetition of pieties.

DALE R. WORLEY
Waltham, Mass.



NINETEENTH-CENTURY FAXES

"Great Expectations: Why Technology Predictions Go Awry" by Herb Brody (*TR* July 1991) was fascinating, but it contained one minor flaw. The first commercial fax machines appeared not in the 1940s but in the 1860s. Fax technology using telephone lines dates from the early twentieth century, with newspaper wirephotos as the premier example.

The mid-1980s boom in fax machines came not only from developments in the actual technologies but also from the introduction of Japanese mass production, innovations such as the "just-in-time" approach, and improvements in supporting infrastructure—for example, high-quality phone lines and lower long-distance rates.

JONATHAN COOPERSMITH
College Station, Tex.

THE MILITARY'S FUTURE

Michael Klare does a fine job of describing the Pentagon's current strategy ("*Behind Desert Storm: the New Military Paradigm*," *TR* May/June 1991). Unfor-

tunately, his article breaks down in its unsubstantiated analysis and clearly suffers from his speculative phobias.

First, let's look at the issue of the military establishment, which Klare fears will be mammoth and sustain budgets at peak levels. It ain't necessarily so. By 1995, the Army's active force will fall to 595,000, the lowest level since 1939. That's a far cry from the 800,000 that remained after the post-Vietnam demobilization. As for the budget, Klare ought to know that it has declined in real terms for more than half a decade and currently hovers at the lowest percent of GNP and federal spending since World War II.

Second, Klare suggests that the military's force structure will lead us into increased interventions and result in waves of anti-Americanism. If that were the case, then the force structure designed to combat the Soviets should have led us into superpower war several times over. Also, I do not know what news he has been following, but the Israelis, Kurds, Iraqi soldiers, and other Arabs I saw during the last "intervention" just about fell all over themselves to welcome American soldiers with gifts and kisses. The same goes for most Panamanians in 1989.

Finally, the New World Order concept that Klare belittles has its foundation in the U.N. charter, which enshrines collective action for the purposes of collective security and multilateral benefit. The end of the Cold War makes such action a real possibility. The president and other leaders in the international arena deserve credit for cooperating to destroy an active threat to world peace.

Ironically, one effect of the Cold War's end has been to remove 50-year restraints on regional animosities that predate our own independence. And humanity has not yet given up the practice of organized murder. Thankfully, the military, charged with protecting us, recognizes these sad facts, even if Klare chooses not to.

ERIC STERNER
Arlington, Va.

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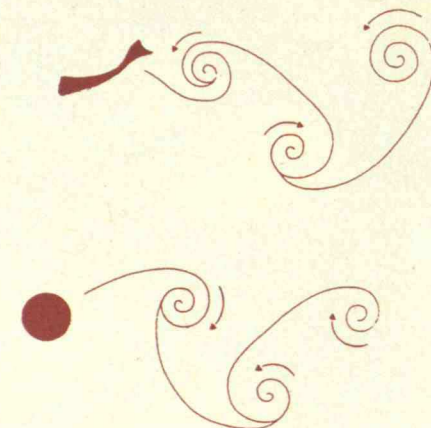
MIT Reporter

TUNA SUB

 Submarine design has missed an important lesson from mother nature, says Michael S. Triantafyllou. Instead of relying on propellers, subs could have tails and swim like fish, according to the MIT professor of ocean engineering. He is designing an automated, tail-flapping sub to try to prove his point.

Fish, Triantafyllou explains, are adept at moving through water efficiently. A five-foot tuna can reach speeds of up to 40 knots, while a comparably powered research sub tops out at 6 knots. Triantafyllou believes he has identified the key to proficient ichthyoid swimming, which has been overlooked by people who previously have tried to build flapping subs unsuccessfully: helpful eddies. A conventional submarine leaves eddies in its wake that create drag on it, but fish flap their tails in such a way that the eddies turn in the opposite direction and help push them along.

Triantafyllou has found that efficient flapping can be described with a simple ratio, relating how long and fast a tail flaps to overall speed. So far, from the



Fish tails produce eddies that help push fish along, while conventional submarines leave eddies that create drag, according to MIT ocean engineer Michael S. Triantafyllou.

goldfish to the tuna to the shark, his theory has held.

For the body of the five-foot prototype sub—which Triantafyllou hopes will rival tuna speed—the engineer and two associate researchers expect to fit

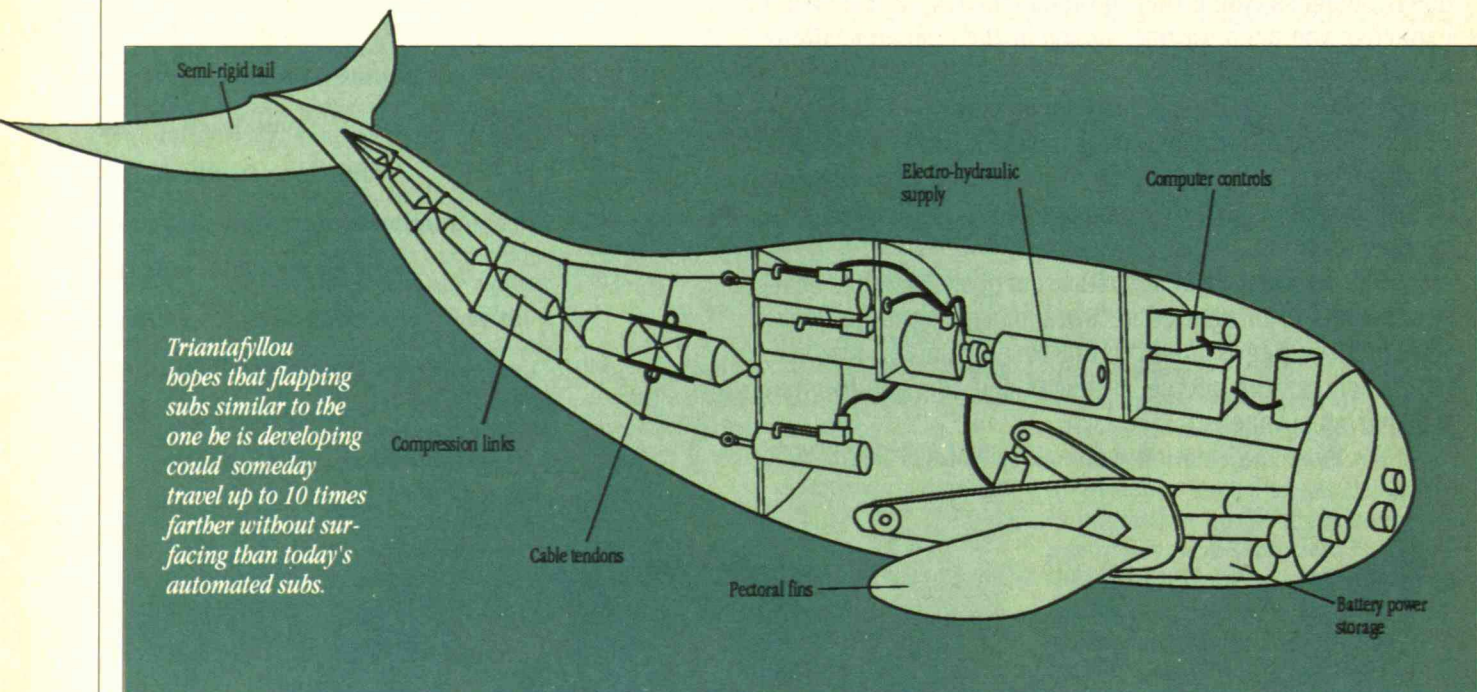
flexible polyurethane skin over a system of pulleys that are attached to a spine. The sub will have a semi-rigid tail and pectoral fins for steering.

If the prototype uses power as sparingly as Triantafyllou estimates, flapping submarines someday could travel up to 1,000 miles before having to surface. By comparison, the best automated subs today can't even go 100 miles.

Triantafyllou says large flapping subs eventually might carry humans. Before that, small automated flapping subs could be used in surveys of large areas of oceans to trace currents and measure levels of salinity and minerals. The subs could also measure levels of carbon dioxide—of interest in global warming studies—and patrol harbors for pollution.

And they might interest the U.S. Navy. "For 'observation,'" says Triantafyllou. "Spying is a dirty word these days." His unclassified project has drawn \$50,000 from Draper Laboratory, which receives military funding, and \$100,000 from the MIT Sea Grant Program. Triantafyllou has applied for Navy funding as well.

Triantafyllou's idea is speculative,



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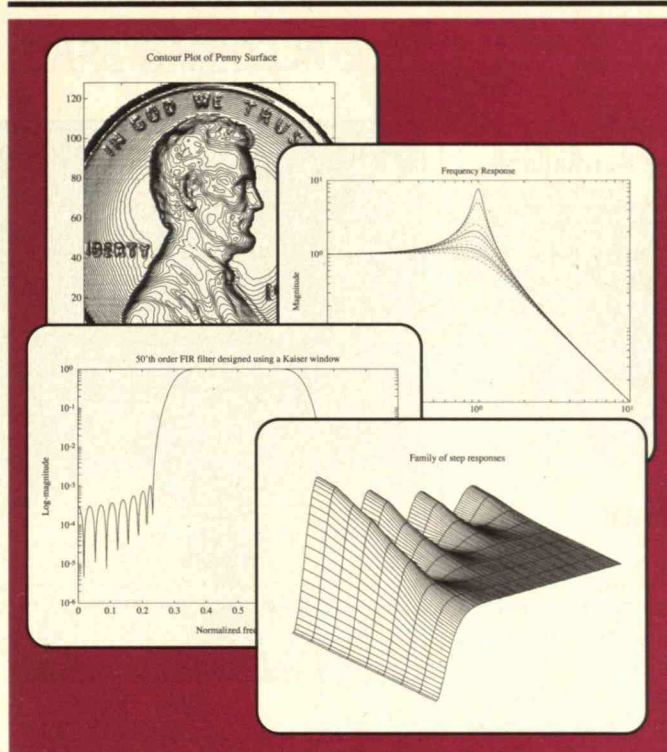
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others note. But "it makes a lot of sense to me," says George Karniadakis, a Princeton University professor who studies fish propulsion for the Navy. "Other ways of propulsion produce noise and drag. This would be smooth." ■

By TIMOTHY F. KIRN, a free-lance science writer and former MIT Knight journalism fellow.

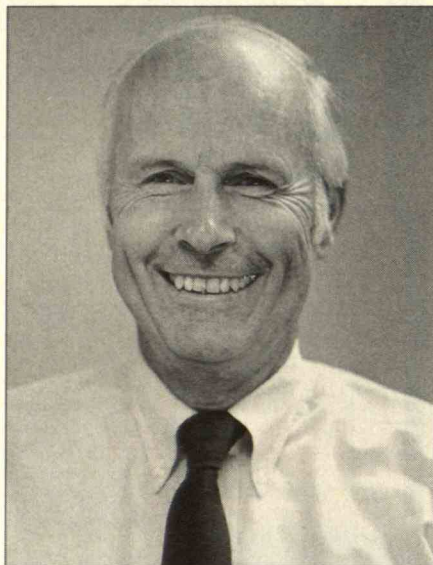
INVENTIONS FOR SALE

 In 1985 Niels Reimers introduced an unusual notion to MIT's patent and licensing office: focus on marketing instead of legal details. Later the school went a step further. It set up conflict-of-interest rules and let professors take stock in companies that license their products.

The result? By 1990, MIT researchers patented 112 innovations and arranged 80 licenses with industry, making the Institute's Technology Licensing Office (TLO) busier than its counterpart at any other school.

MIT researchers weren't always as quick to take their innovations to industry, which, technology transfer experts say, can advance health, safety, and national competitiveness. In 1985, faculty received about 60 patents and set up 12 licenses with companies. H. Kent Bowen, a professor of materials science and engineering who oversaw the changes in the patent and licensing office, remembers faculty members so turned off by the school's patent process that they avoided the place. For instance, he explains, faculty weren't allowed to discuss their work with colleagues until it was protected.

In the year that Reimers took off from his job directing Stanford University's licensing office to work at MIT, several Institute patent lawyers were replaced with scientists and engineers who had been through the product-development process in industry and understood both business and research. The officers advise faculty on patentable technolo-



gies and processes and guide them through patent applications. Then they find a company to license the technology and negotiate terms. While individual faculty hold the patents, MIT and the TLO take a percentage of any license sales.

To direct the revamped office, Reimers hired John Preston, whose experience included co-founding two technology companies. Start-ups risk investing in new technology that government and large companies won't fund, says Preston. Therefore, while his office makes most of its deals with existing companies, the TLO has helped create 39 firms since 1986. In exchange for granting licenses, both MIT researchers and the school itself have taken stock shares in roughly a third of those start-ups.

Controversy Over Taking Stock

Taking equity is controversial because it implies a long-term relationship between a professor and a firm, with the risk that faculty members might redirect research to projects benefiting the company. When universities hold stock, meanwhile, they may be more inclined to build up the company by offering it a first chance for licenses on later technol-



Niels Reimers (left) revamped MIT's patent and licensing office by having it concentrate on marketing. Under John Preston (right), the Institute's Technology Licensing Office has allowed researchers to hold stock in companies that license their products.

ogy.

But in 1988, after devising conflict-of-interest guidelines, MIT officials gave a green light to taking shares worth less than 20 percent of a company's equity. Faculty members who hold shares of a company are not allowed to accept sponsored research from it or to use students for projects with it. And the licensing office has to transfer equity to the MIT treasurer's office, where decisions on the shares can be handled professionally.

So far no MIT faculty member has been charged with improper behavior resulting from connections with industry. But Sheldon Krinsky, professor of urban and environmental studies at Tufts University, points out that there are other hazards to watch for. Promotions might begin to rely partly on a faculty member's ability to "sell" work. Faculty hiring decisions might be made partly on whether an applicant opposes

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As for the waste, independent scientific organizations agree that we can safely dispose of nuclear waste deep underground, in geologic formations that have been stable for millions of years. The waste (used-up nuclear fuel) will be isolated about 1,000 feet below the earth's surface, sealed inside rugged metal containers that are placed in metal-lined holes drilled in rock and plugged with yet more metal or concrete. These multiple safety barriers are as self-containing as nesting dolls. Moreover, the site will be monitored around the clock by highly trained engineers with sophisticated instruments. The

waste is solid (which makes it easy to control) and the amounts are small. In fact, by the year 2000, all the used fuel produced by all of America's nuclear electric plants since they began operating 34 years ago would cover an area the size of a football field five yards deep.

With all of nuclear electricity's benefits, waste disposal need not be a source of concern. Especially considering we have two billion years of experience to learn from. If you would like more information, write to the U.S. Council for Energy Awareness, 1776 I Street, N.W., Suite 400, Washington, D.C. 20006.



the work of an industrial licensee, he cautions.

As for profits, Preston downplays the money the TLO brings in. Although the office should gross \$5 million this year, the net for MIT's general coffers could be as low as \$500,000 after patent costs, inventors' fees, and a TLO overhead of \$750,000, according to Preston. "Our motivation is not to make money; it's to effectively transfer technology," he says.

"All schools will tell you that money is not a priority," says Michael Odza, editor of the newsletter *Technology Access Report*. He explains that not everyone believes universities should charge money for licenses.

Kent Bowen believes, however, that licensing profits are a just reward. When it comes to a legitimate research project, he asks, "Why shouldn't somebody benefit?"

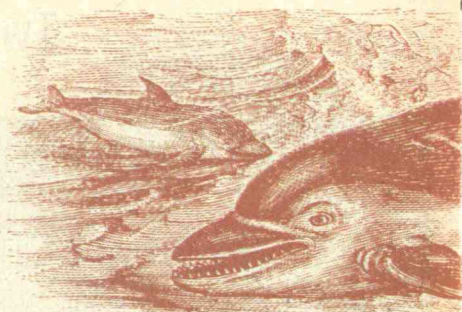
And Preston and Reimers maintain that industry would ignore new technology from outside if companies couldn't obtain exclusive development rights. Preston points to the process of bringing medicine to market: "No company is going to go through the cost of clinical trials and FDA approval, which means spending more than \$100 million, knowing that the next competitor can then develop the same product." ■

By LISA WATTS, a Boston-based free-lance writer.

DOLPHINSPEAK SOFTWARE



Detroit's loss could be dolphin science's gain. MIT electrical engineering professor David Staelin was searching for a simpler way to analyze the clanks and clunks of assembly-line



malfunction. He wound up trying to help biologists learn how and why marine mammals squeak and whistle.

Staelin and graduate student Kevin Christian hope that within a year they will create software to scan a vast audio database for repetitive signals. Such software would solve a major problem at the Woods Hole Oceanographic Institution (WHOI), where biologists are investigating the supposed ability of dolphins

Science and Social Thought

IN SEARCH OF HUMAN NATURE

The Decline and Revival of Darwinism in American Social Thought

CARL N. DEGLER

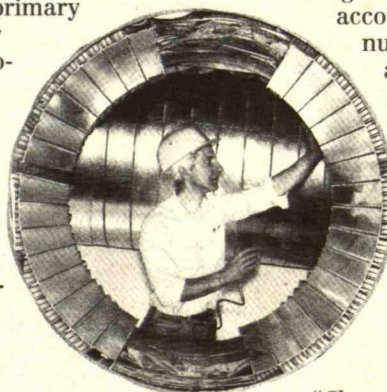
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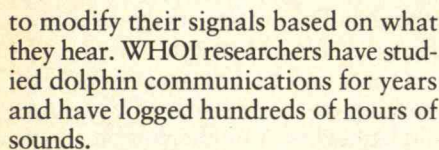
THE VITAL MACHINE

A Study of Technology and Organic Life

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Finding patterns in the signals is a numbingly time-consuming job. WHOI animal behaviorist Peter Tyack explains that his group can differentiate among the signals made by four or five dolphins. "But when you get to 100 dolphins you've got a big, big problem sorting it all out."

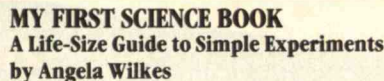
Along came Staelin, who at first wanted to use signal analysis to diagnose problems with machines. He hoped to develop cheap, generic software that could distill the clatter of imminent breakdown from the routine hum of efficient, working machinery. Conventional diagnostic programs have to be custom-designed for particular signals and cost millions of dollars. But the U.S. auto industry, to which Staelin turned, wasn't interested in his long-term project.

When WHOI learned about Staelin's efforts, however, it pricked up its ears. Tyack hopes that the software, which is designed for a personal computer, could be used in the field—aboard a rowboat.

The research may also have medical applications, such as comparing particular electrocardiograms with a library of others. And Tyack says the National Institutes of Health have long been interested in dolphin communication because it might provide insight into how humans modify their speech based on what they hear from others. That could help in treating speech disorders. ■

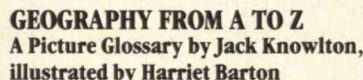
By JOHN PARKER, a free-lance technology writer.

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Trends



Computing with Color

As industry uses robots in ever more sophisticated ways, their ability to see in color could be key to the next generation of machine vision. "For all kinds of applications, color is a wonderful cue that hasn't been exploited yet," says Rochester University computer scientist Dana Ballard. But, he acknowledges, "color is a messy process, and there are a number of nasty problems to solve."

Seeing the world in living color is not a simple all-or-nothing proposition. New York University psychologist Laurence Maloney explains that biological color vision exists at different levels. Just barely qualifying as color vision, the lowest level helps an animal pick out figures that might otherwise be lost in a gray blur. One step up, some animals can discriminate basic color categories—to spot ripe fruit or the warning coloration of a noxious prey.

Human beings enjoy "color constancy." We perceive a rich spectrum of hues

A University of Rochester graduate student in computer science programmed a color-sensitive robot to distinguish among these varied goods.

and see this palette under a wide range of conditions—a rainy morning, the full sun of high noon, or the fading light of dusk. That's because our visual system edits out the distorting effects of background and illumination. Can a computer do as well?

When it comes to designing machine color vision, according to Takeo Kanade, director of Carnegie Mellon's Computer Vision Laboratory, trying to imitate human processes can sometimes burden researchers. Too often, says Kanade, the approach is anthropocentric. "We ask ourselves, 'How do I, as a human being, see color?' and then try to write a program that mimics that." Instead, research should treat "color vision as a physical science."

Glenn Healey, an electrical and computer engineer at the University of California at Irvine, concurs. Conceding that

"it's useful to try to understand how humans process color," he emphasizes that the real technical challenge is modeling "the physics of color image formation and the physics that describe the interaction between light and matter."

Yet even when researchers understand the physics, creating a computer model of color vision is a formidable task. Picture a bowl of apples, with its myriad variations of color, shadow, and reflection. Even worse, imagine the gradations within each object.

Kanade and his colleagues have been working on the problem of glossiness and highlights. A bright glint on an apple, for instance, is not really a different color, just a phenomenon of surface reflection. The challenge is to write a computer program that can distinguish between a highlight and a patch of white pigment. The answer, Kanade says, is to devise algorithms based solely on physical laws of light, matter, and reflection.

Such a model would provide information about the color and shape of the objects as well as about the orientation and color of the light shining on them. It would also help a vision system infer the composition of an object. For example, the physics of color and reflection would help a computer decide whether an apple is real or made of wood, marble, or papier mâché. For both humans and computers, such a determination is more difficult when viewing the scene in black and white.

Color on the Factory Floor?

University of Chicago artificial intelligence researcher Michael Swain believes color may also be an important cue in directing eye movements. The area of sharp focus in human vision is tiny—the width of a thumb at arm's length. Our peripheral resolution is 100 times poorer. That's why we can read only something we're looking at directly. We move our eyes rapidly to provide continuity to this narrow-focus vision.

By contrast, a person's peripheral color acuity degrades slowly, so Swain hypothesizes that colors guide us where to

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focus next. Imitating this method, color cues might direct a robot's eye and help machine vision systems identify objects more quickly. For his doctoral dissertation at the University of Rochester, Swain programmed a color-sensitive robot to distinguish among boxes, bottles, and cans lined up on grocery shelves. According to Ballard, Swain showed "you can have huge databases of objects and pick out the right one in real time."

Manufacturers like IBM have already begun to incorporate color cues to help inspect microelectronic circuits that are becoming more three-dimensional and multi-material. Penn State researchers are working to develop a color vision system for grading fruits and vegetables based on their ripeness, bruises, and so on. And the Department of Defense funds color research because of its interest in camouflage.

For now, however, the color market remains small. The reason, says Robert Shillman, president of the machine vi-

sion firm Cognex, is that "most applications in the factory don't require color—reading serial numbers, tracking items through assembly lines, gauging parts, guiding robotic equipment." Also, gray scales are good enough for many uses, such as sorting colored pills. And for problems that seem to demand color constancy, says Shillman, it may be easier to reconfigure the job.

Still, color researchers envision bright prospects. Since existing applications are all simple, well-defined tasks that can be precisely controlled, the push is to extend the domains under which color-sensitive systems can work. Inspecting an isolated chip is a long way from sending a robot into the dizzy real world of colors. Ultimately, says Swain, "when you give your robot more ways of sensing the world, things become easier." And color is one of the richest cues available, to machines and humans alike. ■

By DAVID BJERKLIE, a science reporter for Time magazine

(Artificial) Germ Warfare

Had Robert Morris waited, the U.S. Army might have paid him for his mischief. Instead, the Cornell University hacker is nearing the end of his sentence following the first major test of the Computer Fraud and Abuse Act. For unleashing a damaging "worm" upon the world's computer networks in 1988, Morris was fined \$10,000 and ordered to do 400 hours of community service; two more years of probation await him.

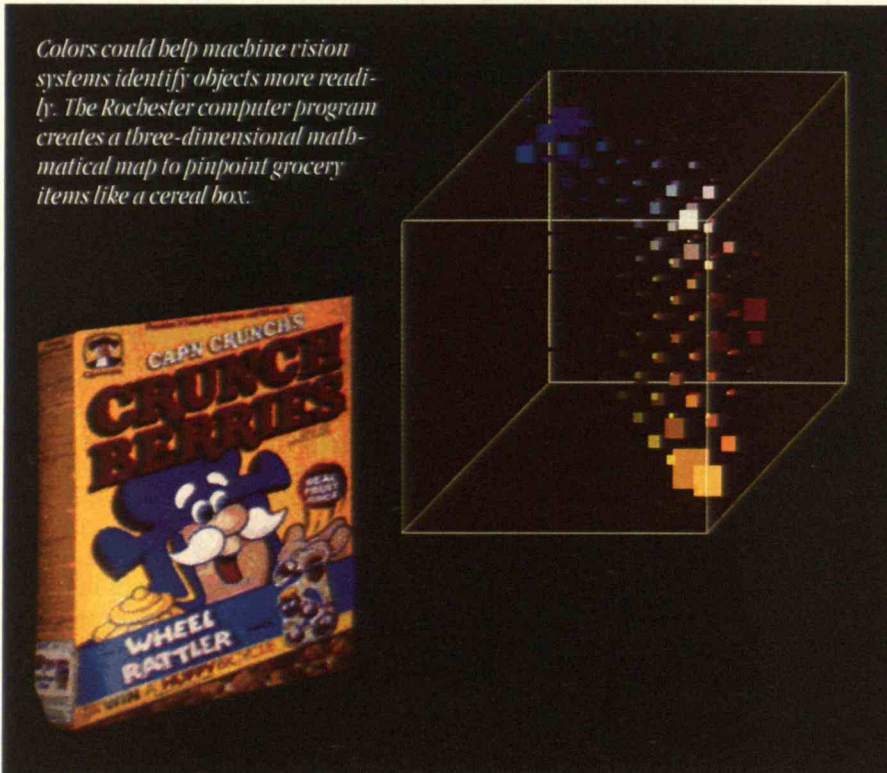
By contrast, Victor Civie and some University of Connecticut schoolmates started a software firm in 1980 soon after their graduation. This fall, his company, Software and Electrical Engineering (SEE), is one of two firms preparing detailed reports for the Army about how to incapacitate computer networks with electronic worms and viruses. The preliminary study will earn SEE roughly \$50,000; if the report passes muster, the company could earn more than 10 times as much during a follow-up phase by devising viruses, demonstrating them, and designing possible defenses.

"Let's face it, this is the Army," says Bob Hein, project engineer at the Army Center for Signal Warfare. "We're in the weapons business." Even before Morris's trial ended, Hein had issued a call for proposals about possible ways to infiltrate computers. In Hein's words, the project's goal is a "weaponized virus . . . malicious software" that can be deployed against an adversary.

To Hein, such research is prudent, reflecting the military's "twenty-first-century reliance" on computer technology. "You'd have to be really obtuse not to see the lethality of this technology," he says. "Obviously, if we can dream up this stuff, anyone can."

According to the 1990 request for proposals, publicized through the Pentagon's Small Business Innovation Research Program, the project aims to "determine the potential for using 'computer viruses'" as a weapon. Specif-

Colors could help machine vision systems identify objects more readily. The Rochester computer program creates a three-dimensional mathematical map to pinpoint grocery items like a cereal box.



ically, the Army seeks "to determine the feasibility of remotely introducing a virus into a system/net and analyzing its effects on various subsystem components." The desired effects include "data (information) disruption, denial, and deception" as well as "effects on executable code in processors, memory storage management, etc."

The Army's interest in this novel form of high-tech warfare comes amid quietly growing infiltrations into computer networks. The California-based Computer Virus Industry Association, a non-profit consortium of hardware and software manufacturers, gets 120 reports of infections from companies and individuals every day, although few turn out to be deliberate or viruses at all. That's up from roughly 3 per month in 1987, notes association director John McAfee.

Some renegade computer viruses are relatively playful, such as a program that flashed Saddam Hussein's picture on computer screens and another that displayed a peace sign on Apple Macintosh screens. However, many viruses damage or destroy computer files. And benign or malignant, all these infections spread surreptitiously from computer to computer via telecommunications networks or hidden with other software on shared computer diskettes.

The Enemy Within?

According to Hein, the Army's interest in viruses stems from a controversial article in the trade publication *Defense Electronics* in 1989. "The application of computer virus concepts," wrote electronic-warfare expert Myron Cramer, "has made possible the advent of a new

class of electronic warfare."

Hein says the Persian Gulf War, the "first modern, computer-age war ever conducted," strengthened his service's resolve to pursue this research. Although low-tech cluster bombs and saturation bombing from B-52s caused much of the death and destruction, computer technology was also critical. For instance, daily computer printouts of operations

gests that perhaps a French science-fiction novel was its inspiration. In *Soft War*, the U.S. Army infiltrates Soviet computers.

Chapman objects to the idea that the Army is perfecting dangerous software while Robert Morris was prosecuted. Even more important, Chapman adds, "unleashing this kind of thing is dangerous." He thinks the chance is very remote of controlling a virus,

which by its nature spreads and sometimes changes wildly,

like the biological

agents it is named for.

Should a virus escape, says Chapman, "the United States heads the list" of vulnerable

countries.

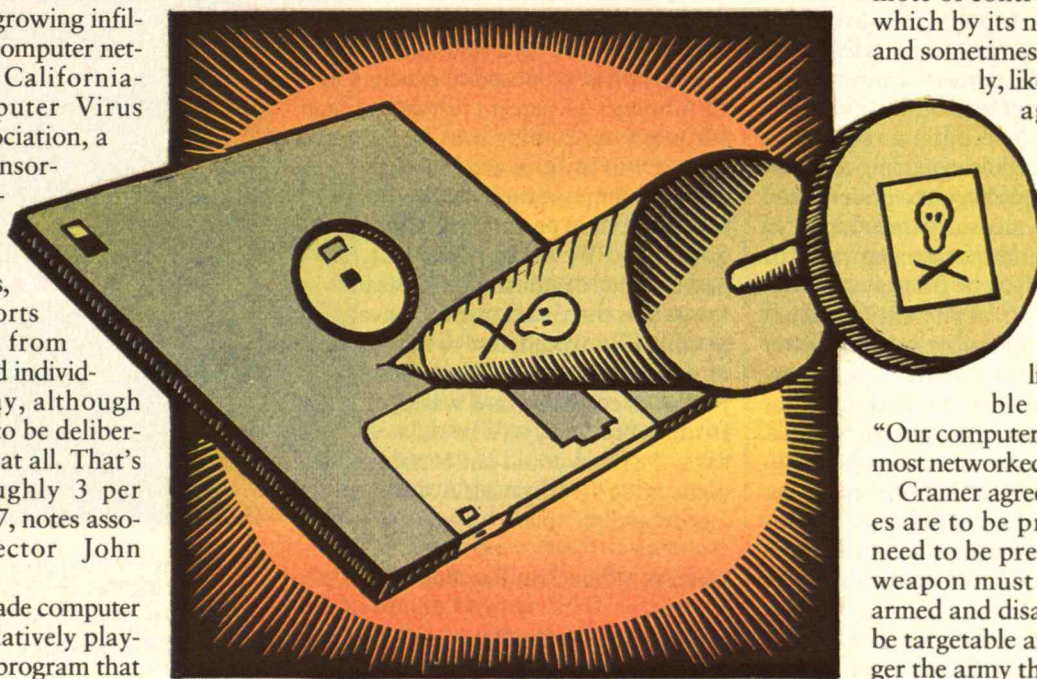
"Our computers are by far the most networked."

Cramer agrees that if viruses are to be practical, they need to be predictable. Any weapon must be able to be armed and disarmed. It must be targetable and not endanger the army that wields it. It is this interest in controlling

electronic arsenals, says Hein, that separates the Army from a hacker unleashing a virus. "We want to know what happens if you design a weapon of this sort. What would it look like, what would it do?"

And Hein insists that the U.S. Army must itself keep ahead of potentially dangerous technology in designing its own weaponry. In fact, he says, this concern influenced the decision to pursue the virus project openly rather than secretly. "Quite frankly, we felt that the people who might know the most about it might not be in the traditional [Defense Department] environment." ■

By SETH SHULMAN, a contributing writer to Technology Review



came to hundreds of pages, field personnel wielded thousands of laptop computers, and sophisticated computer based analyses orchestrated allied bombing raids.

Today, Cramer, a senior associate at the Washington, D.C., consulting firm Booz-Allen and Hamilton, says he doesn't know how real a threat computer viruses pose to the military. Still, he sympathizes with the Army's desire for what he terms an "offensive capability" and says such a program would simply extend existing electronic countermeasures like radar jamming.

However, Gary Chapman, program director of Computer Professionals for Social Responsibility, bluntly calls the Army effort a "stupid policy" and sug-

Muffling the Clean Air Act

In late 1990, after exhausting hearings and nearly a decade of wrangling, Congress passed 700 pages of amendments to the Clean Air Act. Congressional efforts were widely hailed as comprehensive and future-oriented, expanding federal law to encompass a wide range of air pollutants. In signing the act on November 15 President Bush noted, "Every American wants and deserves to breathe clean air."

Today, however, just a year into a compliance schedule extending to 2009, a fight has already begun to preserve and implement the measure's provisions. In Washington and in state capitals, the best intentions may be going awry.

The sponsors of the amended act claimed it would enable states to better monitor and enforce the laws governing emissions of carbon monoxide, sulfur dioxide, nitrous oxides, and particulates. And, they suggested, the law would finally control acid rain and toxic air emissions, two categories of pollutants that had evaded control in both the original 1970 Clean Air Act and its 1977 revisions.

To initiate the cleanup process, Congress gave the Environmental Protection Agency two years to issue technical and legal regulations covering a host of emissions. EPA's regulations would then guide states as they create plans to reach emissions targets. Congress initially appropriated \$400 million for the act, earmarking \$137 million for EPA to give to states as grants.

The state implementation plans are "the heart of the new Clean Air Act . . . the linchpin on which the whole act rests," says Deborah Sheiman, resource specialist at the Natural Resources Defense Council (NRDC). However, states have a great deal of freedom to interpret the federal regulations in preparing the plans, and that may have opened the way for tight state budgets and special-interest lobbyists to sidetrack the act's designs.

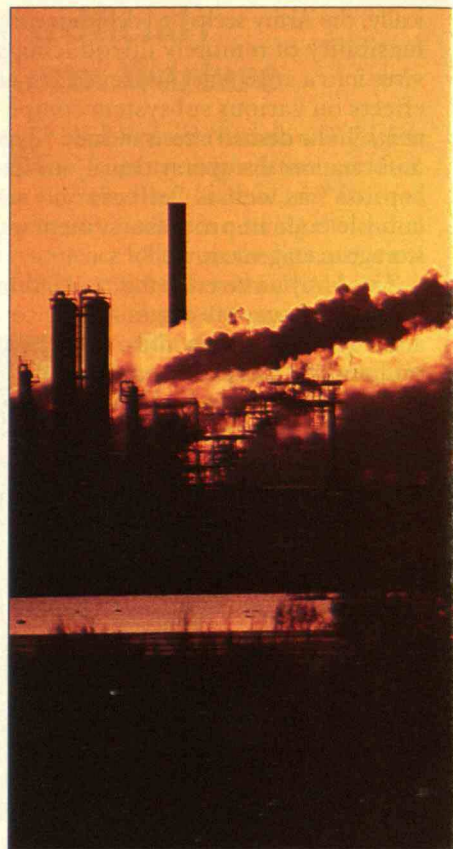
Consider coal-producing Ohio, a state with heavy manufacturing, a new Republican governor who has appalled environmentalists, and a coal-based electric utility industry. Former Ohio Environmental Council director Steve Sedam thinks the motto of the state EPA is to "work with polluters" to reduce fines and ease compliance rather than impose fines or develop strict compliance procedures.

Like many states, Ohio faces a severe budget shortfall. As a result, the general assembly has proposed to cut the Ohio EPA budget 25 percent just as its Clean Air plans are coming due. At the same time, Ohio utilities are lobbying for a 135-day limit on the time the state can take to review permits for solid waste generated by scrubbers. But, says Sedam, that deadline would mean that the two or three staff members available at Ohio EPA would have to table all other permit reviews. "Cities asking for a permit to compost yard waste, or other forms of review, will be delayed," he says. Or Ohio could cut corners in implementing the Clean Air Act, something Congress didn't plan.

Getting What You Pay For

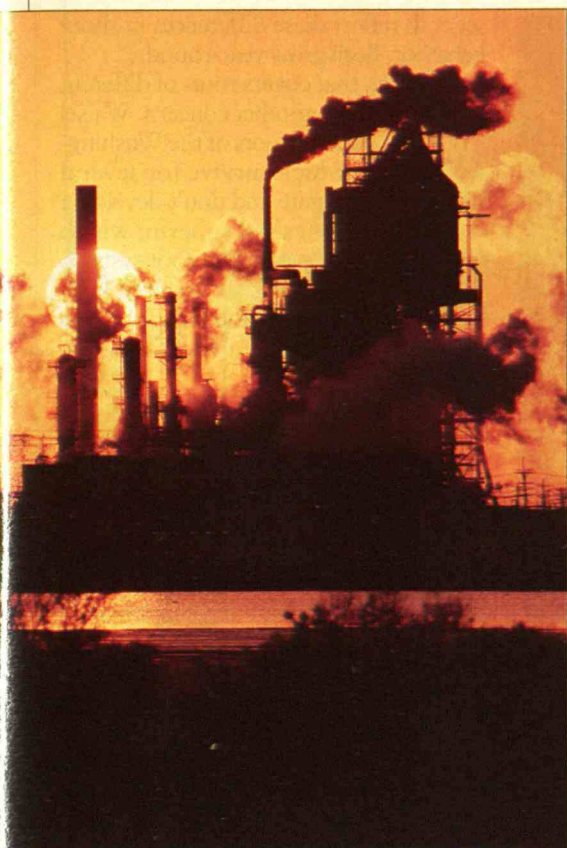
In Washington, the President's Council on Competitiveness is championing an attack on the Clean Air Act as well. Chaired by Vice-President Quayle, the council's goal is reducing regulatory burdens on the free-enterprise system. It has been charged with ensuring that EPA stays within the projected \$26 billion price tag of the new Clean Air Act, and it weighs in on the EPA regulatory process to cut its costs and requirements on U.S. businesses.

In December, the council killed an EPA proposal to require municipalities served by an incinerator to divert 25 percent of solid waste destined for burning into recycling programs. Yet a year earlier, the Office of Management and Budget had approved EPA's plan, which would have required separating paper, aluminum, glass, and yard waste, prohibited incinerating lead-acid car batter-



EPA's William Reilly (left) and Energy Secretary James Watkins smiled as George Bush signed a new Clean Air Act. But many obstacles to enforcing it remain.





tional flexibility." Moreover, although the act stipulates that each permit application must include a schedule and clear method for reducing emissions, the council would exempt most polluters from submitting these compliance plans.

"As it stands now, [the current EPA] proposal contains several illegal provisions," says NRDC's Sheiman. "It effectively blocks out citizen participation from the permitting process."

A final hurdle to acting on the will of Congress arises because, as an EPA staffer put it, "You get what you pay for." While an estimated 2,200 EPA employees work at least part-time on various aspects of the act, the quantity of new regulations and technical analyses threatens to overwhelm staff, many of whom recently arrived at the agency as a result of the 1990 amendments. The acid-rain division didn't exist before November 1990. Yet states are

supposed to cut sulfur-dioxide emissions 40 percent from their 1980 level by the year 2000, and Congress gave the division's 30-plus staff members only until this September to propose ways to help do that.

Lack of federal funding has crippled other important provisions as well. For instance, Congress authorized creating a five-member Chemical and Hazard Investigation Board to look into accidents in the chemical industry, but President Bush included no funding for the board in his fiscal 1992 budget. Nor has he nominated any board members. Yet in the first half of 1991 alone, at least 17 workers died and 250 others were injured in six explosions at oil and chemical processing facilities. ■

By CHRISTINA NICHOLS, a free-lance writer based in Washington, D.C., who specializes in energy and environmental issues

The View Underground

■ "There is one place in the world where you can descend into the lower regions and come up again!" reads a cryptic sign near Tel Aviv University's Sarah Racine Root Research Laboratory.

"This laboratory allows us to observe whole root systems of perennial plants—bushes, trees, ferns—for the first time," says Moshe Agami, director of the university's botanic gardens. Built five years ago, the gardens' root lab is named for its donors, Emanuel and Sarah Racine, whose French name, ironically, means root.

"Speaking about root systems is like speaking of human beings," says botanist Yoav Waisel. "Each one has its own character, individuality, and behavior." Roots largely determine a plant's growth, performance, and fruit bearing. Plowing, preparing seed beds, irrigating, and fertilizing are all directed to producing a good environment for roots.

However, botanic research tends to concentrate on plant stems, leaves, and flowers because they are easier to observe. Until now, most root research had to be conducted either by uprooting—and killing—plants or by briefly observing small plants grown in artificial systems. These methods all have major drawbacks. The roots of plants grown hydroponically (in water) get far less oxygen than they need. With rhizotrons—glass-walled tunnels surrounded by growing plants—only a fraction of a whole root system is visible in the few millimeters between the soil and glass.

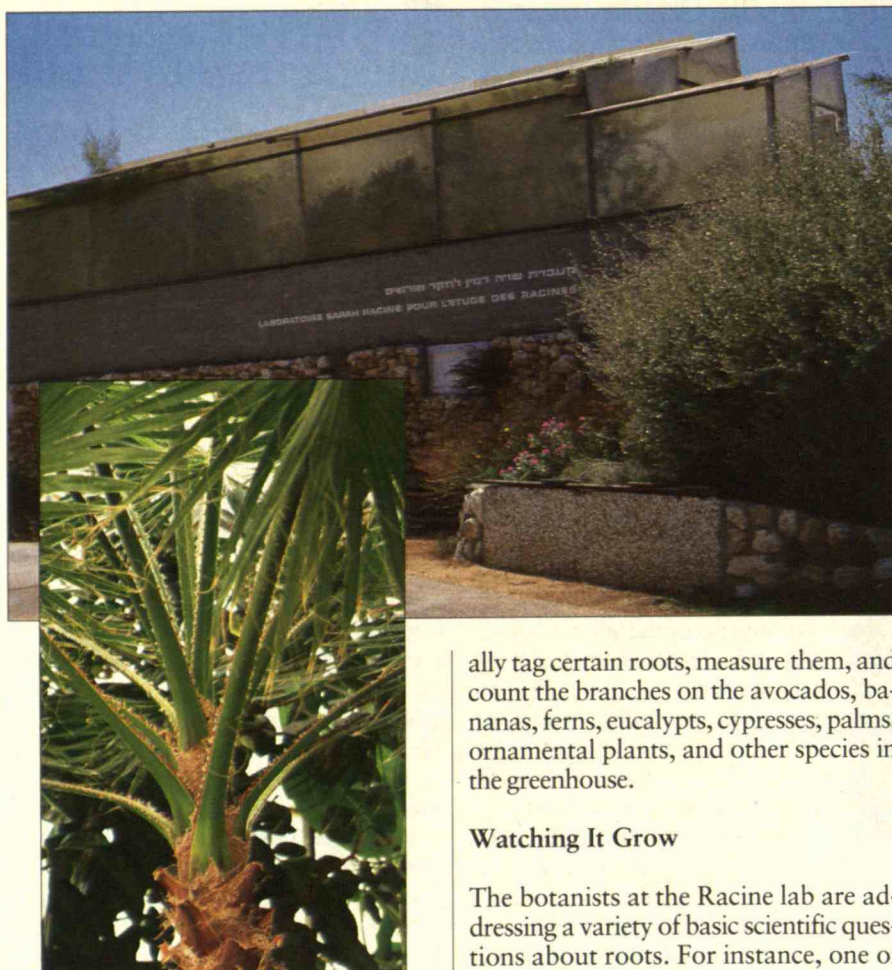
By contrast, the Racine observatory allows scientists to examine several species of roots at the same time and to follow the growth of individual roots that are yards long. And it's the first facility that lets scientists observe and measure whole root systems of perennial plants for the many seasons and years of their existence.

The lab is a large version of aeroponic

ies, and promoted recycling mercury batteries.

That was just the beginning of the council's refashioning of Clean Air provisions. In April, when EPA proposed rules to govern state air pollution permit programs, a section titled "minor permit amendments" brought environmentalists to their feet. As suggested by the council, EPA had changed an earlier version of the rules to allow "a pollution source"—factories, utilities, smelters, and so on—to rewrite their own permits without public notice. State agencies would have seven days to respond, after which the operations could increase their allowed emissions.

In moves still in the review process, the council has also proposed that after a state awarded a permit, a pollution source could change some permit conditions—such as requirements to perform valve inspections or recycle harmful substances—at will in the name of "opera-



Among the subterranean discoveries at the Racine Laboratory in Tel Aviv is that *Washingtonia* palm roots develop no pest-resistant covering.

chambers that researchers have used for several years. In a climate-controlled greenhouse, plants are set into various-size holes in the concrete floor. The roots extend down into a 13-foot-high underground chamber, dangle in the air, and crawl along the 500-square-foot floor. In this damp, dark habitat, the roots get their water and nutrients from fog irrigation for 10 seconds every minute.

Aeroponics provides a uniform environment for experiments and permits researchers to investigate how individual roots of intact systems behave without disturbing them. Researchers can manu-

ally tag certain roots, measure them, and count the branches on the avocados, bananas, ferns, eucalypts, cypresses, palms, ornamental plants, and other species in the greenhouse.

Watching It Grow

The botanists at the Racine lab are addressing a variety of basic scientific questions about roots. For instance, one of Waisel's findings is that some root systems have adapted to their natural environment. Consider the different behaviors of the tropical banana and the *Washingtonia* palm, a native of California. The banana gets water year-round from shallow topsoil, and its large root system dies away almost completely each winter. The palm grows in sandy areas like the Mojave Desert and extends its roots far into the ground to reach water. The roots die only from damage but not old age, so the plants can survive in a desert.

Waisel is also investigating the seasonal behavior of related species. For example, he has compared two native pistachios. One is an evergreen while the other is deciduous, shedding its leaves in autumn and growing new foliage in spring. Surprisingly, the root systems don't

seem to reflect these differences in shoot behavior. Both grow year-round.

The bark that covers roots of different ages and sizes is another concern. Waisel has found that the roots of the *Washingtonia* palm, which survive for several years, remain white and don't develop a cork-like cover called suberin, which protects against pests. The root systems of many other plants are covered with bark. And roots in some positions in a root system produce bark while others don't.

On the drawing board is research to measure drought resistance, which depends on how fast a root grows and extends itself deeper. Resistance to drought or to toxic materials in soil are especially valuable characteristics for agriculture. The Racine observatory makes it possible to directly evaluate the performance of various fruit-tree rootstocks, rather than merely deducing it from the condition of plant shoots.

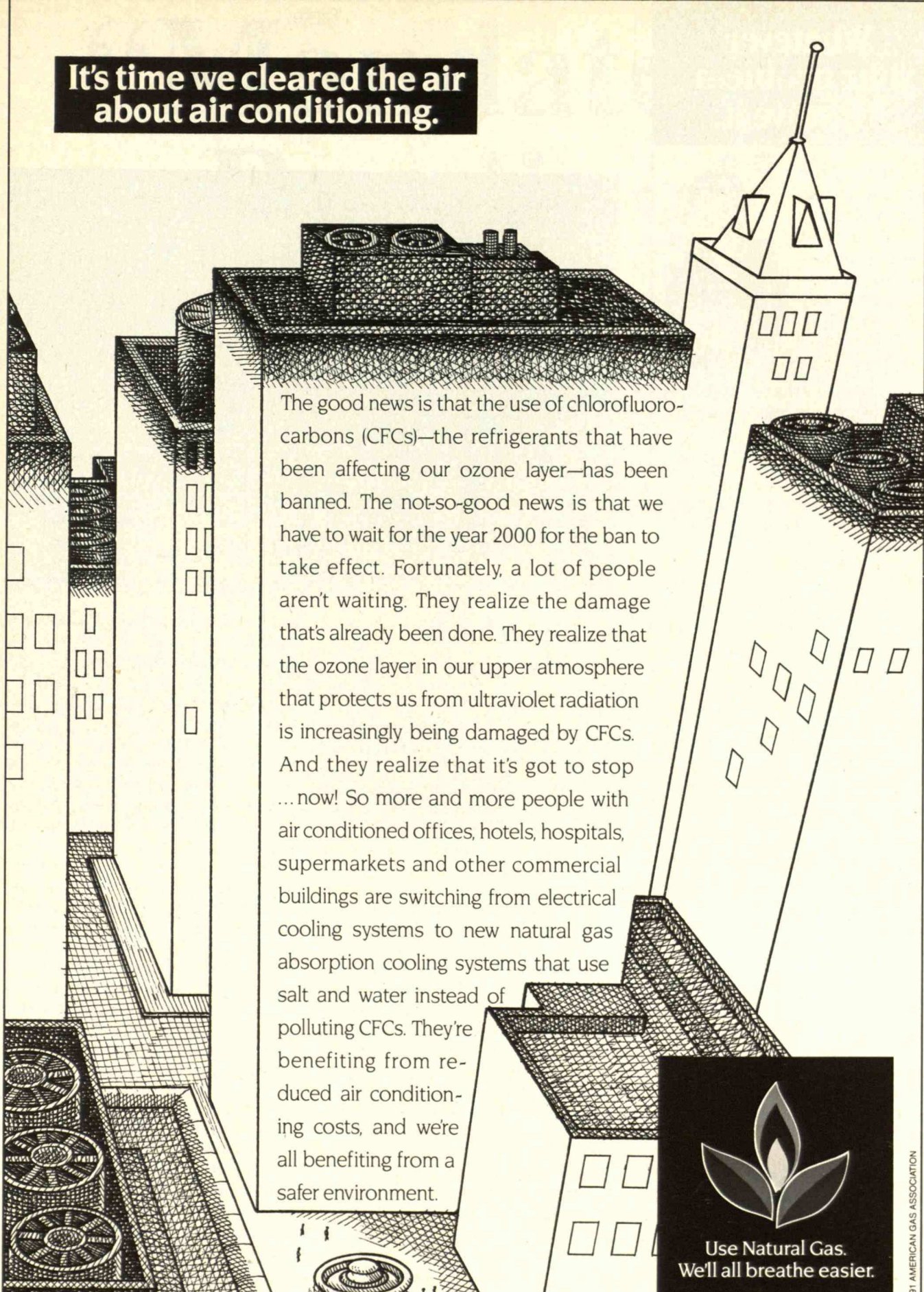
Something that particularly surprised Waisel after five years working at the gardens was how fast some roots advance—one tap root added up to 18 inches a day. "If you had the patience, you could just sit there and watch it grow," he says. "This aeroponic system gives you the opportunity to see the potential of roots to grow without the inhibition of soil or water."

Underground, botanist Amram Eshel shines his flashlight about the dark, moist room to illustrate the point. "The large root system you see here, spreading across the floor in all directions, belongs to the philodendron you saw above," he says. "No one with a philodendron in a pot would ever imagine it was capable of growing such a huge root system."

Eshel's flashlight circles the room. "And the *Washingtonia* palm, a plant that is 10 feet tall, has a root system at least twice that length with many, many branches—probably miles of underground roots. This is something no one has ever seen." ■

By RHODA ELOVITZ, an American free-lance writer who lived in Jerusalem for 12 years

It's time we cleared the air about air conditioning.



The good news is that the use of chlorofluorocarbons (CFCs)—the refrigerants that have been affecting our ozone layer—has been banned. The not-so-good news is that we have to wait for the year 2000 for the ban to take effect. Fortunately, a lot of people aren't waiting. They realize the damage that's already been done. They realize that the ozone layer in our upper atmosphere that protects us from ultraviolet radiation is increasingly being damaged by CFCs. And they realize that it's got to stop ... now! So more and more people with air conditioned offices, hotels, hospitals, supermarkets and other commercial buildings are switching from electrical cooling systems to new natural gas absorption cooling systems that use salt and water instead of polluting CFCs. They're benefiting from reduced air conditioning costs, and we're all benefiting from a safer environment.



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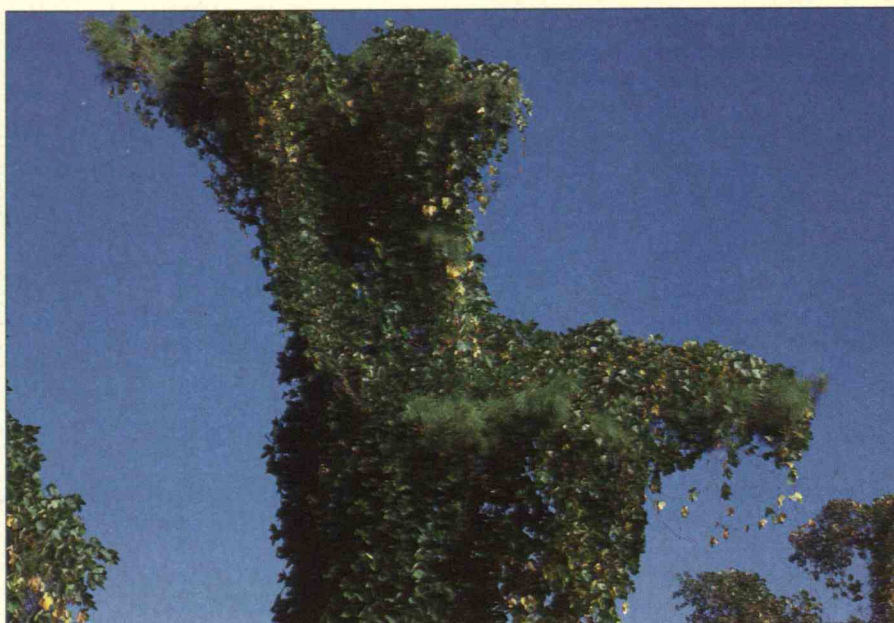
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TRENDS



Is Biotech Safe for the Big-Time?

Since 1986, biotechnology researchers have conducted about 30 approved outdoor tests of genetically engineered microorganisms in the United States. These experiments have released small numbers of novel organisms, typically spreading them over an acre or less. But as biotech and agricultural firms prepare to study the products of genetic engineering on a large scale, most scientists insist that the regulations governing such releases are inadequate.

All outdoor releases so far have been confined to under 10 acres, the Environmental Protection Agency (EPA) definition of small. However, field tests covering hundreds or thousands of open acres are coming soon: the biotech industry must prove to potential customers that its products will work outside the lab and on more than a small patch of land.

Faced with the prospect of multiple large-scale releases, biotech's critics and those who conduct the tests agree on one point: no coordinated framework exists for regulating outdoor studies. The main jurisdiction for approving releases of genetically engineered plants, pesticides,

As larger biotech tests approach, some critics say kudzu—"the plant that ate the South"—shows that a release can go awry.

and microbes falls in varying degree to EPA and the Department of Agriculture (USDA). But these agencies have overlapping responsibilities, which confuses researchers and regulators alike.

Moreover, depending upon a bewildering array of circumstances, the National Institutes of Health, Food and Drug Administration, and Occupational Safety and Health Administration may also play a regulatory role. A few states, such as North Carolina and Wisconsin, have relevant laws as well, and a university biosafety committee may have to approve academic experiments.

"There is uncertainty over whether you need [approval for a release], and if so, which agency will carry it out," explains Alan Goldhammer, the Industrial Biotechnology Association's technical affairs director.

Agreement ends, though, at the need for a coordinated policy. Most biotech researchers would like the federal government to simplify and speed up the procedures for outdoor testing. University of Wisconsin agronomist Eric Triplett argues that it doesn't make sense

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TRENDS

to regulate agricultural and medical products just because they are the fruits of recombinant technology.

Triplett believes that traditional methods of altering genes, such as chemical mutagenesis and conjugation, may actually be far more dangerous—because far more uncertain—than recombinant techniques. Yet no one regulates the traditional methods. “Regulate the product,” not the technology used to create it, says Tripp.

Unique Properties

By contrast, the critics, including a number of environmentalists, want more comprehensive assessments of risks and more public participation in the approval process. The Committee for Responsible Genetics (CRG), based in Cambridge, Mass., is calling for a moratorium on large-scale tests until a tighter regulatory framework is in place. The committee believes that large releases compound the health and ecological dangers posed by laboratory and small-scale tests.

Since none of the current federal laws were designed for regulating biotech, CRG director Nachama Wilker says Congress should write entirely new statutes. For example, USDA has ended up both regulating and promoting biotech, leading to questions about the department’s objectivity. Similarly, according to Wilker, laws like the Toxic Substances Control Act—passed in the 1970s to regulate chemicals—are ineffective for covering “the unique properties” of genetically engineered microorganisms.

CRG is not alone in its concerns. “I’m worried about the accumulation of small problems as these [organisms] are used more routinely,” says Jane Rissler, a biotech specialist at the National Wildlife Federation. She says she worries “about the cascading effects of perturbations.”

Douglas Hoffer, who handles biotech issues in the Burlington, Vt., Office of Community and Economic Development, points to kudzu as a “release”

gone awry. Introduced to the United States to stem soil erosion, it has proved to be an aggressive and annoying weed throughout the South. “We just don’t know enough about whole [ecological] systems,” he says. Burlington and the University of Vermont are attempting to hammer out local guidelines for biotech releases.

Many biotech and agricultural researchers respond that CRG goes too far. “If the same logic applied 50 years ago, we would not now have half the crops we do in the United States,” says University of Nebraska plant pathologist Ann Vidaver—“including such crops as soybeans.” A long-standing member of USDA’s Agricultural Biotechnology Research Advisory Committee, Vidaver agrees that ecologists should be involved more in predicting the risks of a release. But, she adds, the risk assessment process should be reasonable.

After nearly five years of small-scale releases, Vidaver believes, there is little evidence to support concerns over large-scale releases. She terms the results of outdoor tests “undramatic,” with researchers finding essentially what they expected. “[To] condemn large-scale releases just because they are large scale doesn’t make sense.”

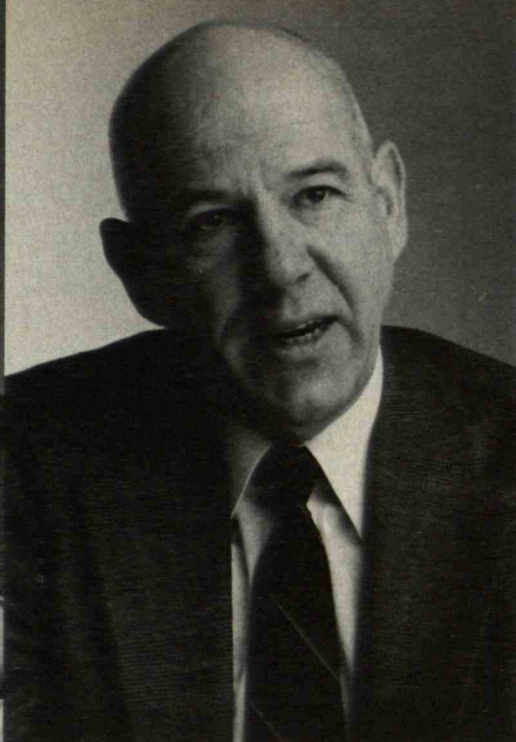
Philip Bereano, professor of engineering and public policy at the University of Washington, doesn’t buy that. He argues that as tests expand from controlled sites to “larger, more open areas, [they] are more subject to the vagaries of the environment.”

Bereano, who has chaired a CRG committee on releases, adds that it is also important to gauge the social and economic impact of a biotech product before assenting to large-scale tests. And, he says, this evaluation should include considerable public participation. “With all the problems of atomic waste and the Love Canals of the world,” Bereano asks, “haven’t we learned from history?” ■

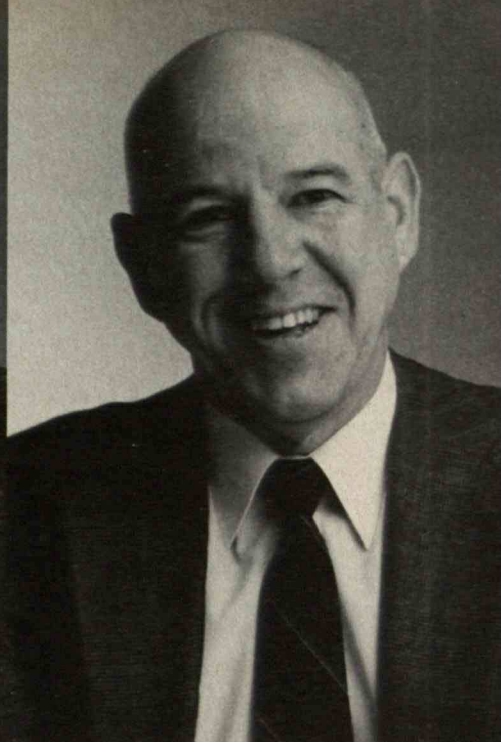
By TOM KIELY, a contributing writer to Technology Review



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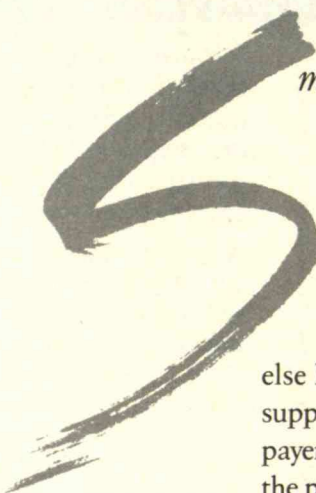
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Peer Review: Treacherous Servant, Disastrous Master

BY CHARLES W. McCUTCHEN

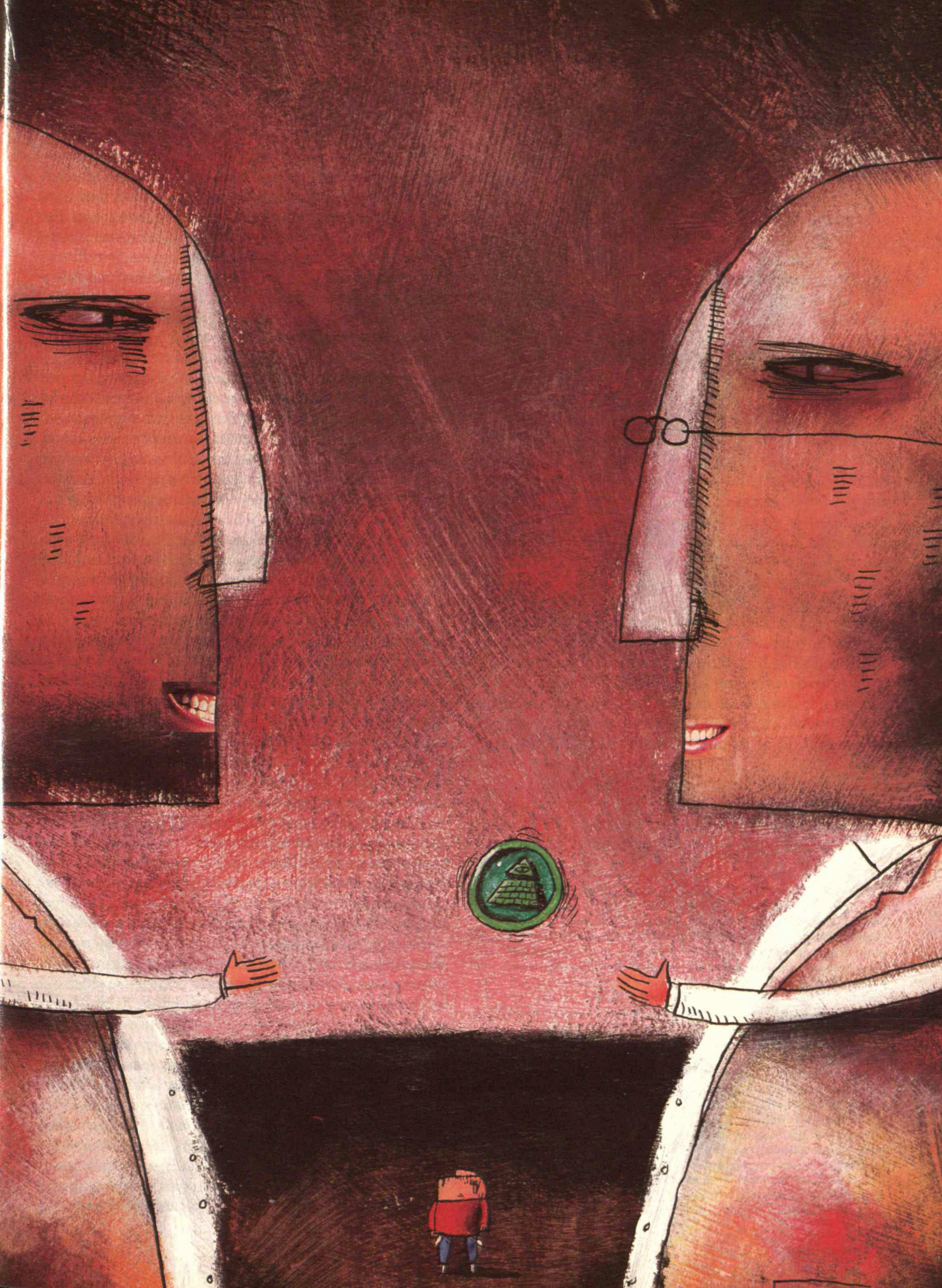
*Peer review, out of control,
makes science a jungle where politics rules
and fraud is tolerated.*



SCIENCE has become a profession: grants and research contracts are what it lives on. Whereas a rich dilettante like Lord Rayleigh could retire to his country estate and do acoustics or whatever else he wanted, modern scientists must sing for their supper. They do not sing to their patron, the U.S. taxpayer. They sing to other scientists, who wield over them the power of professional life and death via peer review.

Peer review, the evaluation of a specialist's work by others in the same field, is an inevitable consequence of specialization. Example: though anyone can tell if a bridge design is truly bad—the bridge collapses—it makes sense to have other engineers check the plans before the bridge is built. Science uses peer review to determine which projects to pay for and which articles to publish, and, recently, to judge cases of alleged misconduct.

Peer review suggests trial by a jury of one's peers, a jewel in the crown of Western democracy—surely an excellent model. But it takes more than a jury to have a fair trial. A lynch mob is also a peer panel. Rules and procedures—jury selection, rules of evidence, the re-



quirement that evidence be heard in public—and a judge to interpret and enforce them are necessary if fallible people are to render fair decisions. Specialist peer review is fraught with biasing influences. Specialists compete with one another and, at the same time, fight collectively for their profession.

Peer review is at best a treacherous servant, but scientists often forget that a jury trial is more than a jury, and act as if the use of peers automatically sanctifies the resulting decisions. Establishment scientists have been treated well by peer review; scientific administrators use it. Both want to believe in it, and the need engenders beatification by faith. "Peer review is the distinguishing characteristic of science," they say. "It makes science what it is."

They are right—in a way. Every scientist is an informal peer reviewer. A scientist's work affects science only if others accept it. But formal review of grant applications, manuscripts, and fraud allegations also makes science what it is, and here human failings can yield improper decisions whose practical consequences and poor ethics propagate throughout science.

Peer review resists investigation. Only insiders know the details of each decision. They may not tell the truth, and the technical background needed to extract the facts is hard for outsiders to learn. Lacking the omniscience of Orwell's Big Brother, we must be content with horror stories of reviewing gone wrong. Though such stories do not directly reveal the frequency of mistakes, they show which human failings are involved, and thus the likelihood of trouble and how to reduce it.

Peer Review and Grant Giving

The federal government uses a variety of ways to decide how to fund science. Department of Defense

CHARLES W. McCUTCHEN emerged from Cambridge University in 1957 with a doctorate in nuclear physics and a gadgeteering outlook. Introduced to joint lubrication by the *New Scientist*, he discovered the physical principle that accounts in part for the low friction of animal joints. Long interest in boats and model airplanes induced self-education in fluid dynamics. He found that the trout tail is a self-cambering hydrofoil, and that the seeds of ash and tulip trees rotate as Flettner rotors as well as spin around their heavy ends like maple seeds. Later, he used shadowgraphs of thermally stratified water to render visible the wake of a swimming tropical fish. In 1980, he published a warning in the *Journal of Aircraft* that the pitching motion of unstable air-

planes should be controlled from the front. Several new and proposed fighters follow this practice.

McCutchen has experienced reviewing both as reviewee and reviewer. Getting published was not a problem in nuclear physics or its instrumentation. At the other extreme, he found the *Journal of Fluid Mechanics* uncrackable.

Seeing his own theory of joint lubrication displaced by what he calls politically enforced nonsense gave McCutchen a strong interest in the influence of scientific politics upon funding and in scientific misconduct in general. His friendship with NIH fraud busters Ned Feder and Walter Stewart introduced him to many instances of fraud, including the Abbs case touched on in this article.

(DOD) managers can fund whomever they like, without having to get advice. They do not compete for contracts with the scientists they might choose. Instead, they shine in the success of the programs they manage, and should something go wrong in a program, the manager is responsible. These are all good features. Unfortunately, managers are subject to agency politics.

As consultant to a small firm, I watched the Navy fail to give a fair hearing to our best idea, *Sea Knife*, a fast boat of strange but simple shape that rides smoothly in rough water. We decided that the Navy's small-boat people would not admit that a craft by outsiders might be better than theirs. But having figured a way around this obstruction, we were funded to build *Wavestrider*, a faster though rougher-riding and more complicated boat. We got unrelated contracts to explore far-out and ultimately unsuccessful forms of marine propulsion. I think these were funded because they threatened no powerful group within the Navy.

At the National Science Foundation (NSF), too, managers make the final funding decisions but with the advice of peer reviewers. Managers benefit from the peers' specialized knowledge but have the authority to correct for peer bias. As at the Defense Department, should something go wrong, the program manager is responsible. For years, George Koo Lea, director of the fluid mechanics program, supported Van Chao Shein Mow, now of Columbia University, for work that was never novel and true at the same time. Workers in his field, the lubrication of animal joints, who disagreed with the professor had trouble getting funded by NSF.

At the National Institutes of Health (NIH), where I have worked since 1964 in biomechanics, optics, and fluid mechanics, peer reviewers effectively make the final decisions; managers are nearly powerless. In each discipline, a peer panel—the study section—evaluates grant applications. By secret ballot, each panel member gives an application a numerical score, and these scores largely decide its fate. An upper, advisory council can fund projects slightly out of the order of their scores without attracting comment, as can program managers. But when whistleblower Robert Sprague, a grantee for many years, did well in the study section but lost out at the advisory council, the event made news.

Since peer review puts a scientist's future at the mercy of competitors, is it any wonder that career issues are a respected, if unadmitted, influence on decisions? Would we not expect mutual assistance pacts to be accepted facts of life? Should we be surprised that politics is especially ripe in disciplines funded by NIH, where the power of scientists over one another is essentially unchecked? Van Mow receives three-fourths of all NIH support of research in joint lubrication and still accomplishes little. For years, those with contrary

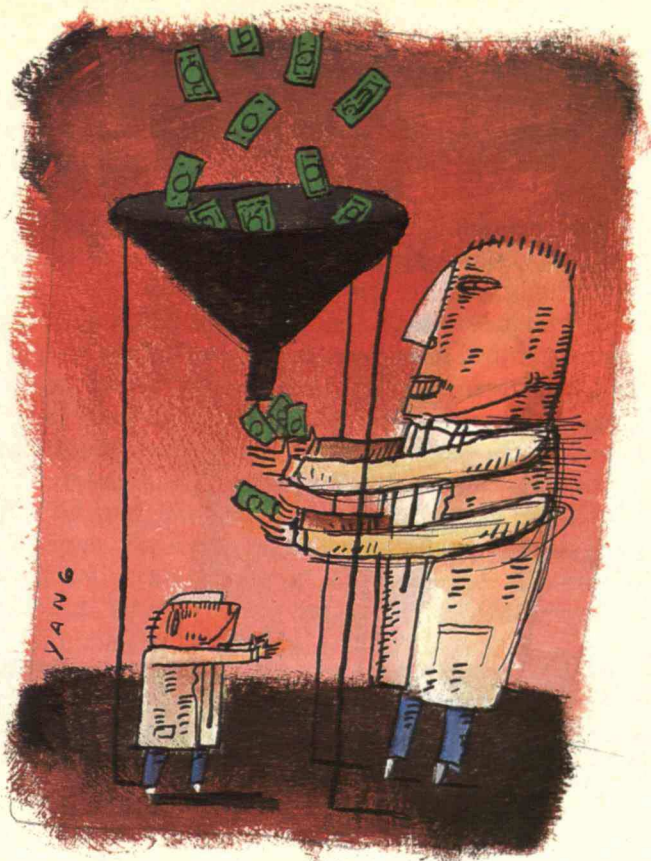
views received none. Support for research on lubricin, the lubricating chemical in joints, ceased in 1982.

Since power over grants confers power elsewhere, dissent in joint-lubrication research appears only in unrefereed publications such as conference reports and public lectures or in journals of distant fields. Timothy Harrigan and his then supervisor, MIT biomedical engineer Robert Mann, made an important contribution to the theory of how cartilage in joints deforms. Refused by the *Journal of Biomechanics*, it was accepted by *Archives of Rational Mechanics*.

If NIH grant administrators made the final funding decisions, they could be called to account for permitting cronyism. But peers are the ultimate authority, and because they exercise this power in secret, no one is accountable. This unaccountability makes the NIH system attractive to management. When a Professor Mow seems to have an inside track, NIH blandly declares that his success shows that his colleagues think well of him. Whoever gets funded, NIH can say the decision was out of its hands. However deserving Dr. X from Rep. Y's district may be, administrators can say they have no way of influencing X's funding. Privately, NIH officials admit there is politics in study sections but say it is a price worth paying to insulate grants in biomedical science from national politics. The cost was surrendering control of funding to scientific politicians.

NIH has one potential lever. The executive secretaries of study sections, who are NIH employees, appoint section members and could use that power to suppress the politics. Although members, who serve for four years, cannot succeed themselves, they expect a large say in the choice of their successors. A section secretary could threaten, "If you misuse your power, your successor will not be from your faction." But such action would require support from NIH management, because section secretaries are not famous scientists. The support would not be given, since NIH conceals this power of appointment. The handbook describing the study sections says that their members are "selected by the NIH" but supplies no details. The impression given is that peer review is above the vulgar mechanics of the appointing process. Without support from above, an executive secretary would need great courage to stop a determined cabal from controlling NIH funding in a discipline.

So cronyism proceeds. In 1976, Mow and Peter Torzilli published two spectacularly erroneous papers on joint lubrication. NIH knew experts held the papers to be nonsense. They predicted such a rapid flow of fluid through the porous joint cartilages that viscous losses would have generated heat 100 million times faster than mechanical work was being done on the joint. Yet Torzilli replaced Mow when the latter left the Orthopedics and Musculoskeletal Diseases Study Section in 1984.



Politics is particularly bad in biomedical research because scientists directly control the flow of money that supports them.



Nastiness
in reviewing
contributes
to a general
unpleasantness
in publishing
and in
science
as a whole.

Inherent Failings of the Project Grant System

Politics is particularly bad in biomedical research because biomedical scientists directly control the flow of money that supports their disciplines. But even without politics, today's grant system, in which scientists propose future research projects to an agency, would be bad. The system gained its popularity after World War II when there were fewer scientists and most projects were funded. But even in those flush times, the Office of Naval Research, Atomic Energy Commission, and National Science Foundation all refused Donald Glaser when he asked for funds to develop the bubble chamber, later the standard device for observing particles in high-energy physics.

The great ideas in science in the next few years will be those not yet thought of. The system ought to select people likely to think them, but, alas, it is inherently biased against such speculation. Granting agencies want certainty, and reviewing peers fear unexpected discoveries by their competitors. As NIH puts it in a pamphlet for grant applicants, "Reviewers prefer limited clear goals that can be realistically approached; rather than broad, multiple questions or vague goals the attainment of which is open to doubt."

The caution of officialdom displays itself in a 1940 report from the Gas Turbine Committee of the National Academy of Sciences: "Even considering the improvements possible . . . the gas turbine could hardly be considered a feasible application to airplanes mainly due to the difficulty in complying with the stringent weight requirements." Thus did great men, including engineer-fluid dynamicist Theodore von Kármán, evaluate the turboprop and jet engine.

The project grant system ignores the range of human talents. As well as inflicting anguish on inventive people, it has no official niche for promoters, people who make enterprises go, people like Vladimir Zworykin who persuaded RCA to spend its money developing television. The grant system does not eliminate such promotership; it just perverts it. Promoters pretend to be great and impossibly active scientists to get money in promoter-scale quantities. They sign every manuscript from their laboratories and accumulate reputations earned by the work of others.

The grant system disrupts the chains of authority and loyalty between scientists and universities. Each university scientist is like a pirate ship raiding the U.S. Treasury. The university provides docking space; in return, the scientist provides for his or her keep, and preferably more, out of grants. To the scientist, the university is a leech; to the university, the scientist is a prima donna. In the middle of these cross purposes, students are supposed to be taught.

Peer Review of Journal Articles

When peers referee journal articles, they perform a valuable service. They find mistakes and sometimes fraud, and they form a trial readership whose reactions show what to change to hold a reader's attention. A referee who knows the field can clarify what is and is not novel in a manuscript. Competent reviews take hours or days of hard work and are a tribute to those who do them.

Unfortunately, the power of referees, usually anonymous, permits self-interest, jealousy, revenge, and other unworthy motives to influence decisions. Dozens, probably hundreds, of letters to the editor over the years show that nastiness in reviewing contributes to a general unpleasantness in the publication process and in science as a whole.

Reviewing weeds out good manuscripts as well as poor ones. Frederick Lanchester's 1894 circulation theory of how wings lift, Chandra Bose's photon statistics in 1924, Enrico Fermi's theory of beta decay in 1933, Herman Almquist's discovery of vitamin K₂ in 1935, Hans Krebs's citric-acid cycle in 1937, and Raymond Lindeman's trophic-dynamic concept in ecology in 1941 all were turned down at least once. Charles Fourier and Gregor Mendel had trouble getting published. We will never know how many deserving manuscripts remained unpublished.

The time and energy spent fighting to be published are lost forever. Lindeman died before his article appeared, and the delay Almquist suffered may have cost him a share in a Nobel Prize. The discoveries by Fermi, Almquist, Krebs, and Lindeman were held up only for a short time, but the circulation theory of lift was delayed over a decade.

My experience has been similar. Since Lord Rayleigh's time, it has been known that the wave nature of light spreads the image of a point source into a blur whose shape on the focal plane is described by the two-dimensional Fourier transform of the lens aperture. The image projected by a square lens is a diamond-shaped array of checkerboard squares. I realized that a Fourier-transform relation between aperture and image also holds true in three dimensions. When I attempted to publish this fact in the *Journal of the Optical Society of America*, referees rejected it. The editor kindly published it in response to my plea. This relation is now the starting point for calculating the three-dimensional resolving power of confocal scanning microscopes.

This evidence is anecdotal, so, by current convention, those who find it uncomfortable can ignore it. But in 1977 Michael Gordon wrote in the *New Scientist* that Henry G. Small of the Institute of Scientific Information had found "a significant negative correlation be-

tween referees' evaluations of [highly-cited chemistry] papers and the number of citations the papers subsequently received." Low citation scores followed high opinions by referees, and vice versa.

The inability of peer reviewers to judge good papers should be no surprise. A discovery is usually a better-than-his-or-her-average product of a brighter-than-average (or perhaps simply unusual) scientist; the resulting paper will likely be reviewed by an ordinary scientist, operating at an ordinary degree of inspiration, and possessing human imperfections. Truly novel papers may not be understood. Those understood will be envied and perhaps rejected with one excuse or another. In 1844, J. J. Waterston tried to publish a paper that anticipated by several years the kinetic theory of Clerk Maxwell and Ludwig Boltzmann. A referee pronounced it "nothing but nonsense, unfit even for reading before the [Royal] society."

These famous examples of rejected discoveries end with World War II. With the rise of grant-supported science, few manuscripts are unembellished reports of discoveries. A discovery is too valuable to reveal in a journal article until it has been used in grant applications. By the time most discoveries are published, they are already on the rumor circuit, and the papers announcing them include data generated in work the grants paid for.

It is follow-up papers that most scientists write and that referees are most likely to approve. A paper starkly describing something new looks strange and will be treated like the proverbial ugly duckling. An example: theoretical treatments of a plate planing on the surface of water like a surfboard demand that a sheet of fluid be ejected forward from under the plate. I found this not so in practice. Instead, there is a tumbling mass of foam where the plate meets the water. When I tried to report this in the *Journal of Fluid Mechanics*, none of the four referees disputed my findings, and three complimented my work. But the four were unanimous that my manuscript could not be published in the journal. One said my account was too sketchy even for a grant application. So far as I know, official fluid dynamics has not yet acknowledged the phenomenon, though my article is now Appendix D in *Planing* by Peter Payne.

Publication can lead to jobs and research support: NIH hired me as a result of my publications on joint lubrication. By denying publication to unadorned discoveries, refereeing obstructs this career channel and drives innovators to the granting agencies and ultimately to the establishment. A deadening uniformity is enforced. Dilettantes are squeezed out, not because they are bad scientists but because they do not belong to the union. This is a major loss. A Parisian gardener was the first to reinforce concrete with steel. Lanchester, in-

ventor of the circulation theory of lift, was a mechanical engineer, not a fluid dynamicist. The inventor of the traveling wave amplifier was trained as an architect, and two musicians invented Kodachrome.

Adding to the number of scientists by drawing from the fat middle of the bell curve of ability may retard rather than accelerate progress. As reviewing peers, the new recruits may silence and starve better scientists out of science. This happened to Douglas Kenyon, who once calculated the flow of water through joint cartilage. He now works for the Marathon Oil Co., and calculates the flow of petroleum through rock.

I call the cooperation of referees with the establishment an "evolved conspiracy." Referees, doing what their personal devils make them do, force innovators into the arms of the establishment, and the establishment is happy with this fact. Were it unhappy, changes would be made.

Misusing Privileged Information

Reviewing of journal articles and grant applications gives reviewers the intellectual pleasure of interacting with authors and proposers, as well as education that, I suspect, has led to more advances than generally realized. These rewards are legitimate. Some rewards are not.

An obvious misuse of privileged information is rejecting or delaying a competitor's paper. The anonymity of referees ordinarily renders this untraceable. In 1978 Vijay Soman and Philip Felig rejected an article on anorexia by Helena Wachslicht-Rodbard and others to ensure priority for an article of their own. The action was detected only because the offenders plagiarized the reviewed article, and their manuscript was sent to Wachslicht-Rodbard for review.

Under cover of anonymity, reviewers can steal ideas from grant applications and manuscripts. There have been many private complaints by apparent victims. Theft is hard to prove, but it is known that the composition of the first material that was superconducting at the temperature of liquid nitrogen was leaked from a paper that Maw-Kuen Wu et al. submitted to *Physical Review Letters*; the leak was revealed because yttrium was wrongly called ytterbium in the manuscript. This error turned up on the grapevine.

A few proved cases do not show that stealing is common. But the rewards are large, especially now that professors must win grants to get tenure and promotions. It is bad form for victims to complain in public. Indeed, it is half-accepted that big fish will appropriate the success of little fish. Jocelyn Bell's discovery of pulsars won a Nobel prize for her superiors but not herself. There was an outcry but not of the size the injustice deserved, nor did the superiors seem embarrassed.

Peer Review and Fraud

The current attempt to deal with scientific fraud is science's first brush with formal self-regulation. Self-regulation of any profession runs afoul of collective self-interest and pack loyalty. When disciplinary committees operate in secret, these influences have full rein. Need I enlarge on the ineffectiveness of the disciplining of doctors by doctors?

Though a few fraud cases are famous, most investigations have been ineffective: a top NIH administrator told me that no university can bring itself to use the word "misconduct." He exaggerated. A very few small fry have been found guilty—for example, the unfortunate Lonnie Mitchell of Coppin State College in Baltimore. He had his grant application prepared by a professional writer who plagiarized someone else's application that Mitchell had provided as a model. Alas, the plagiarizee reviewed Mitchell's proposal.

The vast majority of scientists who stand accused before a university bar of justice are exonerated. Tim Beardsley recently reported in *Scientific American* that the accused was found guilty in only 16 of 110 cases completed by the Office of Scientific Integrity (OSI) since it took over as NIH's fraud squad in early 1989. According to Lyle Bivens, head of the Office of Scientific Integrity Review (OSIR), which oversees OSI for the Department of Health and Human Services (HHS), NIH has reversed only one university exoneration. At face value, this says that most fraud charges are baseless, but we have only the word of the universities and OSI that this is true. Details of the exonerations, including the names of accuser and accused, are secret. (I am suing HHS under the Freedom of Information Act in an attempt to lift this secrecy.) Where secrecy has been penetrated, exonerations have been found to be mistaken. Both the University of Wisconsin and OSI declared James Abbs innocent of Steven Barlow's charge that he had forged an illustration for a journal article by making a smoothed tracing of a figure in an article co-authored by Abbs and Barlow. *Neurology* has published a letter to the editor in which I demonstrated the relationship between the figures. Abbs's published response gave no satisfactory explanation of the resemblance.

A little-known case is revealing. The University of Medicine and Dentistry of New Jersey, and later OSI and OSIR, all told Gene L. Trupin that he was wrong in claiming that Barbara Fadem had stolen his research. OSI and OSIR ignored obvious signs of trouble. Just one example: in defending herself and other members of the university faculty against a lawsuit by Trupin, Fadem said that a journal article he and she co-authored proved that Trupin knew certain facts when the article was submitted. Court records show the facts in ques-



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tion were added to the article at the proof stage, 10 months after the date of submission. OSI knew about this dodge at the time it found Fadem innocent. It also knew that the suit was settled out of court in 1988 with a \$60,000 payment to Trupin.

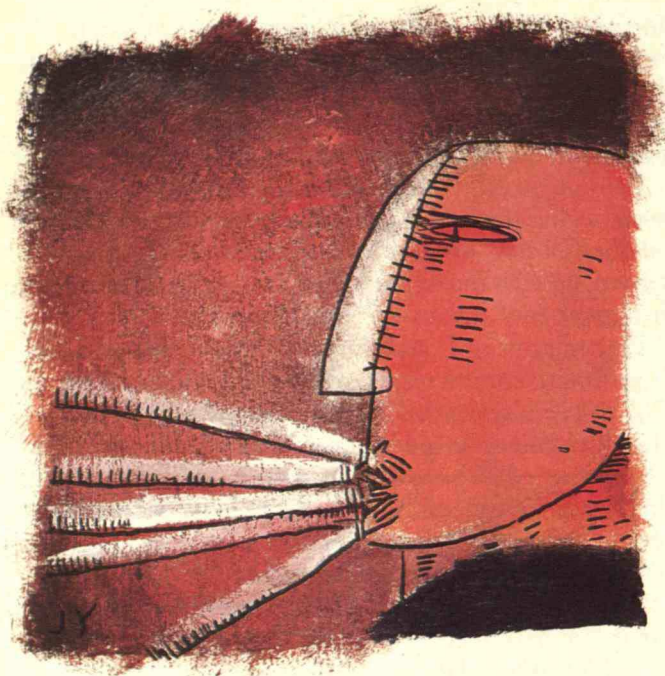
As long as NIH's watchdog is blind to evil when it wants to be, is it any wonder scientists learn that ethical pliability is a professional necessity, and find it prudent to discover that what looks like fraud is a "scientific disagreement," an "error," or "sloppiness"?

One might think a determined whistleblower could force OSI to conduct a real investigation. Not so. Once OSI receives an accusation, it tells the whistleblower little or nothing. As the whistleblower who got the Abbs case reopened I was volunteered no information: OSI's predecessor office did tell me to prepare a 10-minute presentation, but I was never summoned to make the presentation, nor told it was called off. Meanwhile, OSI's impenetrable secrecy encouraged Abbs to complain that his constitutional rights to due process were being trampled. He sued and won on a technicality. DHHS is both appealing the verdict and, as the judge required, going through the steps laid out by the federal Administrative Procedures Act.

Universities routinely use peer panels to investigate and judge fraud. This shifts responsibility but does not get justice done. A powerful accused scientist or pack solidarity can frighten a panel into seeing no evil. The panel that the University of Wisconsin convened to investigate Abbs's alleged faking ignored blatant inconsistencies in his submission. For example, Abbs falsely claimed that accuser Steven Barlow had displaced one record before comparing it with the other. The public gaze might shame a panel out of doing a whitewash, but panels operate in secret. Incredibly, in its filing under the Administrative Procedures Act, DHHS proposes that determinations of guilt no longer be printed in the *Federal Register*. Secrecy, secrecy, ever more secrecy.

Secrecy gives full rein to subterranean forces, and a major scientist can bring great force to bear. Panels at MIT, Tufts, and NIH all said, wrongly, that no misconduct was involved in a paper co-authored by Thereza Imanishi-Kari, Nobel laureate David Baltimore, and others. It is a matter of record that Baltimore used both a letter-writing campaign and professional lobbyists in an unsuccessful attempt to get Congress to halt Rep. John Dingell's (D-Mich.) investigation of the matter. (It was Rep. Dingell's investigation that finally forced NIH to mount a real investigation of its own.)

Media interest in the Baltimore affair is more than instinctive celebrity chasing. Fake work impedes progress much more if a major scientist is involved than otherwise, because others must pretend to agree with it if they want jobs or grants. I know of no attempt by



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other scientists to duplicate the precise experiments in the Baltimore affair. Scientists supposedly delight in proving one another wrong, but they hesitate to embarrass someone with power and the willingness to use it.

Because no one at NIH is accountable for the decision to fund Professor X, no one feels betrayed, no one is angry or ashamed if X commits fraud. So NIH washes its hands of the matter and passes off the consequent cover-up as political realism. As an official in the Department of Health and Human Services said to me about OSI: "They have to compromise." Expedient exonerations are excused as being for the good of science. If the public got the idea that a lot of fraud exists, the argument goes, it might not support research. The whistleblower is, figuratively, given a loaded pistol and told to do the proper thing.

According to the *New York Times*, retired Harvard microbiologist Bernard Davis believes it would have been better had the Baltimore affair been dropped. The biomedical science establishment would rather let fraud continue than have it publicized, a policy that will keep fraud going forever. Concealment requires that the sinners keep their funding. Abbs and his laboratory received millions in government support after the initial brushing off of the complaint against him. So long as such scientists are protected and fed, their species will multiply.

By not using its control over who gets funded, NIH has given up the power that would go with being paymaster. Despite signing \$7 billion a year in checks for research, NIH was unwilling or unable to prevent MIT's whitewash of Imanishi-Kari, Wisconsin's of Abbs, and numerous similar instances.

Were NIH to invoke its power of the purse, a university might say it was applying improper influence, a confrontation NIH evidently fears. James Wyngaarden, ex-director of NIH, and Joseph E. Rall, ex-deputy director for intramural research, have both said that universities have run ineffective investigations, but NIH has never punished—or even tongue-lashed—they for doing so. Nor has it said that running a bogus investigation is unethical. Yet unless NIH greatly expands OSI, the agency will depend on university investigations of fraud.

Compare NIH with NSF, where managers make the final decision about who gets funded. With responsibility comes accountability—for such odd decisions as siting the National Earthquake Engineering Research Center in Buffalo, N.Y., rather than in California. One can also question the reasons for moving the National Magnet Laboratory from MIT to Florida State University. But whatever one may think of them, these decisions show that NSF has power. If NSF wanted a

THE NATIONAL MAGAZINE AWARDS

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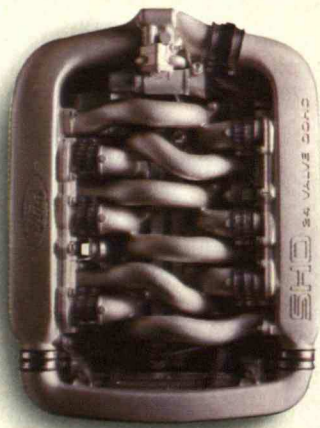
by the Columbia University Graduate School of Journalism
on behalf of the American Society of Magazine Editors

Judith Nette

Richard [illegible]



We've mixed business
with pleasure.



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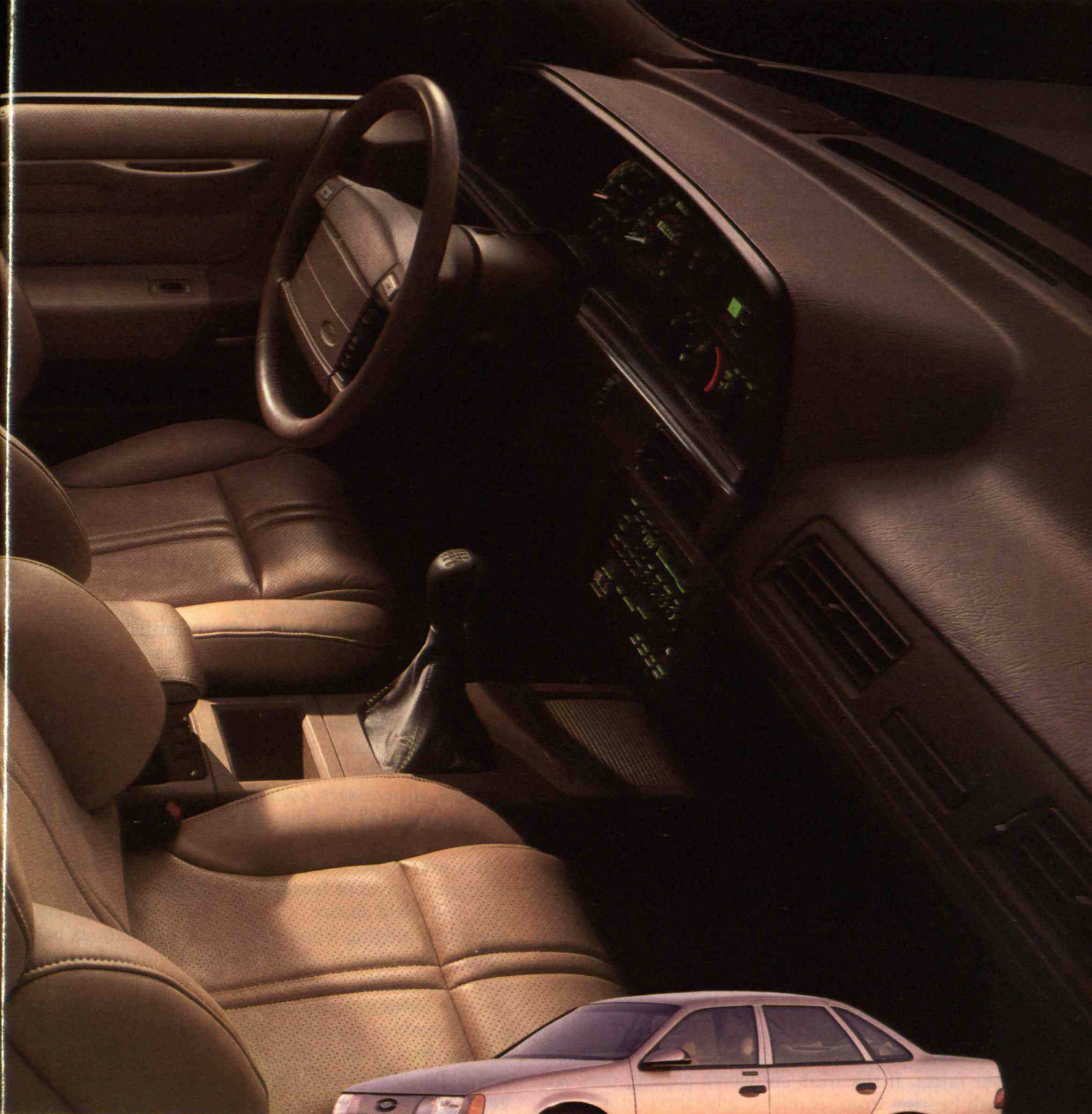
S H O

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university to investigate a fraud, the school would remember the movability of laboratories before doing a whitewash. Perhaps this power is reflected in the apparent lack of fraud in the parts of science NSF funds.

Taming a Fractious Horse

■ *Reform the grant system:* Suppose politics could be eliminated from NIH study sections. Suppose DOD and NSF program managers were all smart and incorruptible. The project grant system would still be a time-destroying Moloch, demanding and reviewing long applications, most of which are not funded, and it would still sponsor sure things rather than imagination. Block grants to universities would be better. The schools would decide who to support however they wished, using any system they wished, from despotism to democracy. Universities have made good choices in the past. The University of Michigan found the initial, essential money for Donald Glaser's bubble-chamber research.

Each year, universities would go to the federal government and argue for support. Let them bring citation scores, rumors of Nobel Prizes almost awarded, whatever they want. Out of this free-for-all, a formula would emerge, no doubt with loopholes and exceptions, and the negotiators would return home exhausted and tell the troops how they made out. The mutual dependence of scientists and brass would develop the loyalty upward and downward that makes institutions bearable to their members.

Under the block-grant system, everybody in a university would be in the same lifeboat and would benefit collectively from one another's success. Still, researchers would continue to compete within the school, so to dull the teeth of university politics, perhaps 10 percent of federal support should remain as grants to individuals.

■ *No-fault publication:* Specialist journals should never reject. If scientists are worth paying, they are worth hearing from. A referee who thought a paper wrong could try to argue the author out of publishing it, invoke a six-month cooling-off period, impose a length limit of a page or two, and have signed comments published along with the paper. If no-fault publication results in a flood of garbage, it shows that scientists are creating garbage. Better we learn about this than conceal it.

General-circulation journals like *Science* and *Nature* would still reject most manuscripts they receive. Their editors, not reviewers, should make the final decision. Editors are the filter that catches reviewer misbehavior. Essay-form reviews can be windows into a reviewer's motives, and having one reviewer from out-

side the specialty under review is a wise precaution against discipline politics.

Editors of all journals should ask reviewers to be as kind as possible, and authors should know the identity of writers of adverse reviews. A referee whose identity is known is less likely to steal from a paper, reject or delay it for professional advantage, or be pointlessly nasty. On the other hand, favorable reviews should be anonymous to discourage reviewers from trying to curry favor with authors. There is no way to keep them from informing authors privately, but the rule would remind them it is unethical.

■ *Fraud:* The fraud problem reflects the ethics at the top of biomedical science. By not retaining for itself final authority over funding decisions, NIH left this power ungarded for ambitious scientists to pick up. With power came arrogance and the feeling that rules were for lesser beings. The cure is obvious. End the carving of their own cake by biomedical scientists, and the steamy politics will dry up.

If funding is not reformed, the scientific establishment will remain the problem, and the solution must come from elsewhere. John Dingell cannot interest himself in every fraud case, so the public's sense of fair play must be enlisted as a force for justice. Whistleblower and accused should know everything that occurs at every stage of an investigation so they can object and, if necessary, complain in public. The final conclusions of all fraud investigations should be made public.

If a peer panel has to make the final decision, as it might in cases of fraud, only extraordinary measures will yield justice. Because panel members are specialists judging fellow specialists, precautions beyond those in jury trials are needed to counter the effects of politics and pack loyalty. Accused and accuser, or their advocates, must have the right to question panel members in public about decisions before they become final. Unless these or very similar reforms are instituted, OSI should be closed, because it cannot yield justice.

Using peer review is like riding a fractious horse. One must understand its bad habits and never let it forget who is boss. Kept under control, peer review can yield good advice. Given its head, it will hurt people, serve the interests of the reviewing peers, and warp the institutions that use it. Where possible, peers should not make the final decisions but should advise the decision makers, who can filter peer self-interest from peers' recommendations. As a fractious horse is only as good as its rider, peer review is only as good as the program managers and editors who use it, but these people are visible and can be called to account for their decisions. ■

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COVER

The Classes of '76, '81, and '86 pooled their party spirit and held a reunion dance at the Science Museum that featured a DJ, an international spread of hot and cold hors d'oeuvres, and, of course, lots of fooling around with interactive exhibits. Photo by Barry Hetherington



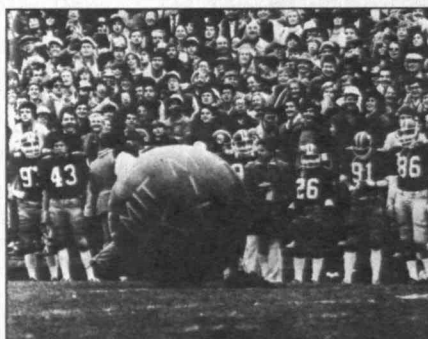
LETTERS

WHO REALLY DUNNIT

With the arrival of the July issue of the *Review* this morning, I find you have made a horrible mistake and feel strongly that an apology is due to the ATOs.

You have blamed them for something they did not do and I am sure they are suffering undue angst from ragging and jibes. If you will read the enclosed documentation you will find the ATOs did not do the dastardly deed; the Dekes did it.

JAMES M. WHITE, '28 (ΣT-ΔKE)
Nashville, Tenn.



Yes indeed, we have grievously erred. Mr. White is referring to the article on campus humor on page MIT 2 of the July TR, in which Alpha Tau Omega was given credit for having perpetrated the great balloon hack at the Harvard-Yale game in 1982. It was Delta Kappa Epsilon, not ATO, who should be blamed/admired. Sincere apologies all around.—Ed.

INFORMATION PLEASE

While planning my 25th reunion, I had occasion to meet with various members of the Alumni/ae Association to discuss what we could do for MIT. I proposed a database that could help students, faculty members, and graduates locate alumni/ae with special skills or interests. When talking to Bill Hecht, '61, executive VP and CEO of the Association, I found that he had recently written an article for the April issue of *The MIT Faculty Newsletter*, recommending that they take advantage of the expertise of the 90,000 alumni/ae when setting up seminars, helping students with theses, etc. I thought that his article was excellent, but felt that without the ability to browse through a large database, the idea would

be difficult to implement. The type of queries are limitless, but typical of what I had in mind were:

Q: Who, in New England, is designing sub-micron integrating circuits and would speak to students?

Q: Is anyone doing research in nuclear-reactor safety?

Q: Is anyone at a company in the chemical industry that would accept students doing term projects or theses?

I'm sure that any of you could think of other appropriate questions to help people in the MIT community make useful connections.

Obviously a lot of thought must be given to the questionnaire from which such a database could be built, and there would be implementation costs. But I believe that these costs would be greatly outweighed by the benefits.

If you think that my suggestion has merit, I would ask that you publish my letter and suggest that alumni/ae vote with a 29-cent stamp. If there is sufficient interest, it is likely that the implementation money can be found.

JOHN RUDY, '67
Lexington, Mass.

BLACKBOARD JUMBLE

I bring to your attention the attached page, facing MIT 46 in the May/June issue of TR. It appears to me the background mathematics includes an error, as noted, i.e.,

$$\frac{n^x}{n^x} = n^{(x-x)} = n^0. \quad (\text{not } n^{(n-n)})$$

As a former office mate of Chuck Vest, I just had to write! Perhaps the error is deliberate, to see how carefully we read TR.

EDWARD R. LADY, SM '49
Ann Arbor, Mich.

Well, now that you mention it, perhaps we should include in each issue a deliberate error of this sort to keep readers on their toes. But the real explanation is more prosaic. For the photo session, Mr. Kuhnle obliged the photographer by quickly scribbling an equation on the board—with no time to check his work. We'll have to start proofing photos as well as text!—Ed.



Lorenz Receives Kyoto Prize

The 1991 Kyoto Prize for basic sciences has been awarded to Professor Emeritus of Meteorology Edward N. Lorenz, ScD '48, for his pioneering work on the study of mathematically chaotic systems in nature. He is the fourth member of the MIT faculty to be honored with a Kyoto Prize, given annually in three categories—the basic sciences, advanced technology, and the creative arts.

Now a senior lecturer in the Department of Earth, Atmospheric, and Planetary Sciences, Lorenz was cited by the prize committee for establishing "the theoretical basis of weather and climate predictability, as well as the basis for computer-aided atmospheric physics



Edward N. Lorenz, ScD'48

and meteorology." Lorenz, the committee said, had "made his boldest scientific achievement in discovering 'deterministic chaos,' a principle which has profoundly influenced a wide range of basic sciences and brought about one of the most dramatic changes in mankind's view of nature since Sir Isaac Newton."

The Kyoto prize, which has been likened to the Nobel Prize in prestige and monetary value, is worth 450 million yen, or about \$300,000. The prizes have been awarded since 1984 to recognize outstanding contemporary intellectual and artistic achievements. They are made possible by an endowment from Kazuo Inamori, chairman of the Kyocera Corporation.

Previous MIT faculty winners were Claude E. Shannon, PhD '40, (1984) for his pioneering work in information theory; Morris Cohen, '33, (1987) for his contributions to metallurgical science;

More than 1,000 sailors attended MIT as participants in the Navy V-12 program, July 1943 to June 1946. With efficiency that would do credit to a military

campaign, the veterans of V-12 are preparing now for a national colloquium in November 1993 to mark the program's 50th anniversary. Alumni/ae of 131 colleges

and universities that were V-12 sites are being invited to the celebration, which will be held in Norfolk, Va. The information number for the V-12 Planning Committee is (703) 73-8510.



and Noam A. Chomsky (1988) for his revolutionary theories on the nature of language.

It was in the early 1960s, in the course of his work on weather systems, that Lorenz found he was getting chaotic results from some of his calculations. Convinced that these inconsistencies were not caused by faulty data or computer errors, he began to study chaos itself. His early insights, published in his 1963 paper, "Deterministic Nonperiodic Flow," marked the beginning of a new field of study. Some scientists have since asserted that the 20th century will be remembered for three scientific revolutions—relativity, quantum mechanics, and chaos.

The study of the rules of chaotic disorder is making an impact not only on the field of mathematics but in virtually every branch of science—biological, physical, and social. In terms of the atmosphere, it has led to the conclusion that it may be fundamentally impossible to predict weather beyond two or three weeks with a reasonable degree of accuracy.

Born in West Hartford, Conn., in 1917, Lorenz received an AB in mathematics from Dartmouth College in 1938, an AM in mathematics from Harvard University in 1940, an SM in meteorology from MIT in 1943, and an ScD in meteorology in 1948. It was while serving as a weather forecaster for the U.S. Army Air Corps in World War II that he decided to do graduate work in meteorology at MIT. □

Space à la MODE

An MIT engineering experiment designed to study the mechanical behavior of future space structures will fly aboard the space shuttle *Discovery* this fall. Up until now the experiments performed in the shuttle have been of a scientific nature, rather than engineering.

MODE, or Middeck 0-Gravity Dynamics Experiment, was developed by Professor Ed Crawley, '76, director of the Space Engineering Research Center, and his team from the Department of Aeronautics and Astronautics. It will



combine two small-scale tests of "non-linear," gravity-dependent mechanical behavior: the sloshing behavior of fluid in a tank and the vibration characteristics of truss space structures. The behavior of stored fluids and truss joints will have a direct effect on future space missions.

The MODE experiment is part of an unusual joint effort among a university research group, the government, and an industrial group (McDonnell Douglas Space Systems Co.), to develop small, technologically innovative experiments. McDonnell Douglas will eventually apply the technology to the Space Station. The value of the project, according to Crawley, lies both in the university-industry-government cooperation and in the fact that the project has involved researchers at all academic levels—undergrad, graduate, and post-doctoral. The knowledge gained from MODE, Crawley said, should be applicable to a wide range of future space activities. □

Biology Requirement Approved by Faculty

At long last biology takes its place in the pantheon of required undergraduate subjects at MIT, beginning with freshmen entering in the fall of 1993. After years of study and

discussion, the faculty voted in May to add modern biology to the core requirements of chemistry, mathematics, physics, and eight subjects in the humanities, arts, and social sciences that all undergrads must take. MIT is believed to be the first university in the country to make biology a requirement for all its students.

Professor Richard Hynes, PhD '71, head of the Department of Biology and a Howard Hughes Medical Institute Investigator, said that the new requirement will be "very valuable for all of our students and invaluable for many of them." Biology has undergone vast changes in the last generation, he said, and it is important "for students to understand the intellectual basis for this revolution. Molecular and cell biology are already impacting on society through their effects on medicine and in the biotechnology industry. Genetic counseling and genetic engineering will affect all of our lives and an educated scientist should understand this material and have a grasp of its impact on society."

The new requirement will introduce the intellectual structure of modern biology. The core materials will deal with the definitions of genes, biological coding and information transfer, the structure of proteins, the concepts of biological specificity, the generation of energy in living systems, the structure of cells, the regulation of biological systems, the development of multicellular organisms, and biological diversity and natural selection in the evolution of life. The subject will be offered in several versions, each of which will in addition address a different key area, such as medical genetics, physiology, biotechnology, and ecology/environmental biology.

"The new requirement is an excellent example of how one builds from a research orientation to bring cutting-edge work into the undergraduate curriculum," said President Charles Vest. "A research revolution in molecular biology, in which MIT was among the leaders, has led to a set of academic subjects regarded as part of the core education experience that we will require of all people who are going to emerge from MIT." □

Studying Disease to Illuminate What Is Normal

The title for this year's Technology Day program, "Sex, Drugs, Genes, and Obesity," was a little tongue-in-cheek. The committee figured everyone knows that MIT scientists are serious, particularly when dealing with grim realities like AIDS, genetic disease, heart disease, and cancer. But organizers wanted to send a signal that the speakers would take every opportunity to be lively and even amusing. After all, this was a rare opportunity to showcase the accomplishments and some of the stars of the Biology Department, to which President Charles Vest referred in his remarks as "one of the jewels in the crown of MIT."

The department is large—home to 60 faculty, 170 graduate students, 200 post-doctoral fellows, and almost 300 undergraduate majors—and its doctoral program is consistently ranked first in the nation. But it is relatively unknown to many students and alumni/ae because until the faculty approved a change last spring, a biology subject was not included in the Institute Core Requirements (see page MIT 4.)

Professor Harvey Lodish, whose job it was to set the scene for the morning's exposition, established the reductionist theme: the MIT Biology Department's goal is to understand at a molecular level how genes work, how they are regulated, and how proteins (whose amino acid sequences are encoded by the genes) work to carry out the important reactions in cells. "An enormous unification of all life forms is at work in this endeavor," he stated. "We also study disease, the aberrant, in order to understand what controls the normal."

Reading the Code

The first speaker was Eric Lander, one of the unlikeliest denizens of a biology department anybody is apt to find. Lander holds a Ph.D. in pure mathematics, and spent the last 10 years at the Harvard Business School teaching

courses in managerial economics and bargaining. Now he is the director of MIT's Human Genome Center. All he will say about this career change is "Boston is full of talented people and there are so many productive collisions." Whatever the reason for the new direction, his enthusiasm for his present work is palpable.

"In the past, human genetics relied on being clever, making inspired guesses," Lander said. "Now, instead of guessing *what*, we can figure out *where*. And we have the possibility of understanding, at its most fundamental level, any trait."

Where to start? "There is a clear pattern of inheritance in many diseases," Lander said. "And we can map those patterns—that is, provide a correspondence between the presence or absence of the disease and a DNA sequence difference. (See the "Short Guide to DNA" on page MIT 8.) The difference is not generally the cause of the disease, but merely a marker to signify its presence near the responsible gene on the chromosome."

"After all," he explained, "your DNA and my DNA are almost, but not quite, identical—about 99.9 percent equivalent in sequence." But, with 3 billion bases (see box) in the entire human gene complement, that means 3 million differences. By using enzymes that cleave DNA strands at very particular sites, one can observe the differences, and correlate them with the inheritance of diseases.

As an example, Lander pointed to cystic fibrosis, a common inherited disease. "By using these novel chemical techniques, we can narrow down the location of the problem," finding first which chromosome is involved, then which gene in that chromosome, and ultimately reading the sequence of bases in the gene itself. What scientists found when they compared the normal gene with the CF gene is that only one amino acid was missing—a very small alteration that is enough to make important differences in the function of the protein

*"Biology used to
subsist in
Buildings 16 and 54,
in a positively
medieval setting,
but things
have improved."*

—Harvey Lodish





"There are important misconceptions about this work—among them that 'genetic' means 'predestined.'"

—Eric Lander

"If you want to live a good life, you have to take some risks. A truly safe level of cholesterol you wouldn't want to attain."

—Richard Rosenberg



that leads to the disease.

The goal of the Human Genome Project (HGP), he stated, "is to fill up the pictures of chromosomes with labels. First, we'll construct a genetic map—the locations of the polymorphisms [or differences] that will serve as markers to localize particular genes. Then will follow a physical map—overlapping DNA clones, spanning the entire genome. Thus, a student looking for the gene for Huntington's disease could go to the shelf, and take down tubes 98, 99, and 100, and be sure that in one of them, there would be a piece of DNA with that gene on it." (When Lander says "clones," he doesn't mean a full-grown replica of Adolf Hitler or Elvis Presley, alive and well, living in Argentina. He is describing the amplification of a particular segment of DNA, grown in a bacterium or other suitable system, to the level where one has enough to perform experiments—such as sequencing it.)

"The final step is a sequence map—the complete sequence of the entire genome—3 billion bases. We don't have the technology yet to finish that phase, but the first two steps are easily within our grasp." Lander isn't discouraged that the complete sequence is, at this point, unattainable. "Biology and computer science share at least one feature—the technology advances in a log/linear fashion. If we encourage the technology, the sequencing phase of the Human Genome Project could be finished a lot sooner than we [now expect]."

The simple Mendelian diseases—diseases that appear to be caused by the inheritance of a single altered gene—will be cracked first, Lander said. "We'll know which genes are their basis, and, in some areas, how they cause problems. We will also have insights into the rare diseases, in which one person in a million is affected." Is this important? It can be. For example, Werner's syndrome—advanced accelerated aging—will tell us a lot about the mechanism of aging.

Next, Lander sees breakthroughs in our understanding of diseases involving more than one gene and diseases of complex inheritance (involving an as yet unquantifiable interaction between genes and environment), such as Alzheimer's, some cancers, heart disease, hypertension, diabetes, and autoimmune diseases.

"There are important misconceptions about this kind of research," Lander cautioned. "Among them are the ideas that 'genetic' means 'predestined'; that in the nature versus nurture debate, nature has won; that there are 'good' genes and 'bad' genes; that genes directly control behavior; and that genetics limits human potential."

Any one of these misconceptions could have launched a morning's discussion, and Lander had time for just one counterargument: "Is there a gene for intelligence?" he asked. "In a way, yes. But it is 100 percent controllable by the environment. The disease phenylketonuria (PKU), if undiagnosed, leads to profound and irreversible mental retardation. Yet, a simple dietary constraint (avoiding foods containing the amino acid phenylalanine) alters the course of the disease, and the 'victims' are perfectly normal. It's an example of how the knowledge of the mechanism of a genetic change leads to an interdiction."

It was clear during the question and answer period that many of the T-Day attendees were skeptical about the value and impact of the HGP. Lander admitted that increased ability to predict future genetically related problems offers the threat of penalties as well as hope for treatment or avoidance. Decisions about how to use genetic information will be made not by scientists, Lander said, but by the public, through its institutions and regulatory agencies. So a public understanding of genetics is critically important, in his view.

In a refreshingly candid summing up, Lander said "we shouldn't try to overstate the importance of the Human Genome Project. We will shed light on the gene—but what will flow is not necessarily cure or cause or prevention—rather, understanding."

Broken Hearts

Half a million Americans die each year from acute heart attacks; the survivors often have significant disabilities," Professor Richard Rosenberg reminded the Technology Day audience. Rosenberg works at the interface of basic science and medicine, studying the mechanism of blood clotting and the natural history of the cells that line the inside walls of blood vessels. Both of these disciplines have made him an expert in the molecular development of atherosclerosis. His work puts him in a position to give some encouraging news about prevention and treatment to counter the grim statistics. Not only is Rosenberg an authority in the field, MIT is the site of one of three national Centers of Excellence in the study of cardiovascular disease supported by the National Institutes of Health (NIH).

"Lipid transport is vital to cell membrane formation. Wound healing helps repair the inevitable damage of living. And blood clotting is literally essential to life. But all three contribute to the incidence of heart attacks," Rosenberg explained.

Consider the consumption of cheese-cake. "Cheesecake," said Rosenberg, savoring the word so you knew this was more than a convenient abstraction, "is rich in lipids, including cholesterol and triglycerides. Part of this dessert is transformed into energy, and part is placed in storage. It's the storage part that can cause problems.

"Cholesterol is shuttled from place to place by protein/lipid conjugates, among them the low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs)," Rosenberg said. "Both have gained notoriety in the popular press as 'bad cholesterol' and 'good cholesterol' respectively, a designation loosely based on their abilities to deposit or remove cholesterol.

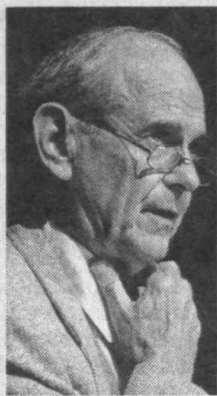
"With time and abuse, wounds accumulate [in the circulatory system]—high blood pressure exacerbates the process—and cholesterol becomes part of the wound-healing mechanism. The smooth muscle that lines the vessel begins to enlarge in response to the healing process, lipids and cholesterol are incorporated into the cellular infiltrate, and the opening in the artery slowly closes."

Finally, a clot heralds the denouement. A clot involves a complex cascade of enzymatic events. Some initiate the formation of the clot, some enlarge it, and others start its dissolution. But the trigger is almost always a congregation of platelets, tiniest of the cells in the bloodstream. "Once the platelets begin interacting with the walls of a narrowed vessel, the enzymatic activation commences, and a clot is virtually guaranteed," Rosenberg went on. "But there are ways to utilize our knowledge to develop therapeutic strategies."

By now everyone has heard of the fundamental preventive measures: eat less cholesterol-laden food and get moving. "Exercise seems to elevate HDLs," Rosenberg noted, "and a 1 percent decrease in the blood level of cholesterol [through dietary restraints] results in a 2 percent decrease in the likelihood of a heart attack." Lowered blood pressure also minimizes the stress on blood vessels, and can reportedly be controlled via relaxation techniques.

But who wants to pass up the cheesecake to take a walk? What happens when bad things happen to good-intentioned people? "There are a variety of therapies available," Rosenberg said, "based on each stage of disease. For example, aspirin inhibits the platelet aggregation and activation that is the first step in clot formation. There are anticoagulants that inhibit most of the clotting enzymes. The downside is the possibility of excessive bleeding."

Once the clot is formed, is all lost? The



"HIV, the human immunodeficiency virus that causes AIDS, is the best studied and most thoroughly characterized pathogenic virus."

—Herman Eisen

"When people move, they seem to acquire the cancers of their locale, providing a compelling argument that lifestyle is an important factor."

—Robert Weinberg



most recent innovations, Rosenberg noted, involve the plasminogen activators, which trigger production of the enzyme that dissolves existing clots. "These drugs have really revolutionized treatment of patients who recently suffered a heart attack and have increased survival rates. But the side effects, as one might imagine, include increased likelihood of bleeding," possibly even a fatal cerebral hemorrhage. Obviously, it's better for the individual to prevent rather than treat. Cheaper, too.

But Rosenberg counseled moderation in all things, particularly moderation. "If you want to live a good life, you have to take some risks. A truly safe level of cholesterol . . . well . . . you wouldn't want to attain."

AIDS and Immunology

When Professor Herman Eisen took the podium, the topic moved to AIDS, a disease he pronounced the MIT Biology Department "uniquely poised to understand," thanks to its rich complement of virologists, molecular biologists, and immunologists.

Eisen, whose speciality is immunology, recalled his first encounter with the then-unnamed affliction. "My son was a medical intern at Bellevue in New York City, and he called me with a detailed description of these patients he was seeing. They had a new, strange disease. Their immune systems had collapsed, and they suffered from a variety of opportunistic infections, the sorts of ills that we could shrug off with no problem. He wanted my advice, my help. I had no clue. I could offer nothing. I felt helpless," Eisen said, capturing the feeling most of us have when confronted with this profane affliction.

Countering that helplessness is a massive research effort. HIV, the human immunodeficiency virus that causes AIDS, is the best-studied and most thoroughly characterized pathogenic virus, Eisen said. HIV is one of a large group of viruses whose genetic material is RNA, rather than DNA. These so-called *retroviruses* use an enzyme called reverse transcriptase to make a DNA copy of their RNA genome. This copy is duplicated to make double-stranded DNA, which then embeds itself into the host chromosome. "There's no way to tell, from the outside of the cell, that it's infected," Eisen said. "The viral genes can reside for years, possibly until the cell is activated. Then, the viral DNA is transcribed back into RNA, and a new virus particle is synthesized. The cell is destroyed, and more viruses are released."

Furthermore, antibodies, the usual first line of defense against infections,

but it is true that Stanford had negotiated a total of more than 100 exemptions from the cost-recovery rules (MOUs), as compared to the institution with the second highest number, Cal Tech at 13, or MIT, third at 10. Further, ONR had not initiated audits of Stanford's indirect costs for the previous 10 years.

In August 1990, ONR began to look into Biddle's charges, but by then he had the ear of a higher-profile ally, John Dingell, who had an impressive track record of going after misspent government funds. (It was a Dingell subcommittee investigation that made the \$650 toilet seat cover a national catchphrase for waste in military spending.)

Dingell notified Stanford that he was sending a team from Congress' General Accounting Office, augmented with investigators from his subcommittee. Auditors soon found, included in "the equipment depreciation pool, part of which was allocated to Organized Research," a yacht, first described as a 65-foot vessel, later established to be the 72-foot, Jacuzzi-equipped *Victoria*. The fact that taxpayers were subsidizing a yacht was leaked to the press and became the symbol of the arrogance and "expectations of grandeur" with which Biddle said the Stanford higher echelons were infested.

Leaks from the investigation continued through the fall and winter, each compounding the picture of extravagance and irresponsibility. In January, President Donald Kennedy announced that Stanford was voluntarily withdrawing more than \$500,000 in overhead claims. By March, when Kennedy endured a grilling before Dingell's committee, there came the first public notice that other universities were checking their own knitting: Cal Tech withdrew some \$500,000 in charges, including a Palm Springs retreat for its board of trustees.

Dingell sent a letter to the members of the Association of American Universities (AAU), a group of leading research universities, requesting that they review their books carefully and report any inappropriate indirect charges. Harvard Medical School, Yale, and Cornell announced that they were withdrawing charges. On April 17, Dingell informed MIT that an investigation by the Gov-

ernment Accounting Office was underway. And on April 24, MIT announced that it was repaying \$731,000 in charges accumulated from 1986 to 1990, noting that as its studies continued, more errors might be found.

The issue of administrative costs associated with research took on a life of its own; the genie was out of the bottle. No federal agency could be seen to be lax in its watchfulness over the public purse.

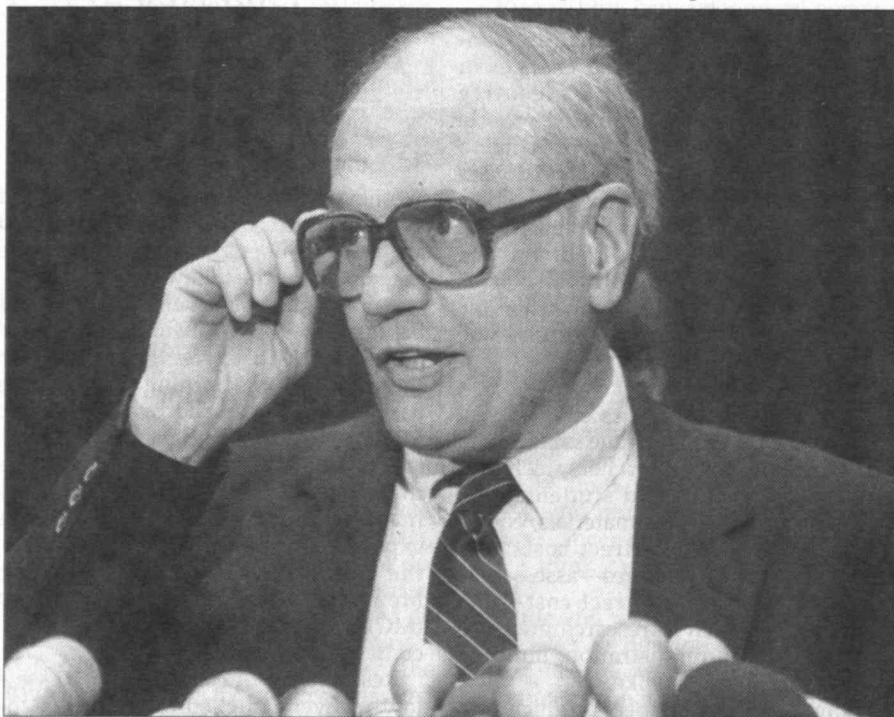
In May, the *Boston Globe* reported on page one that the Department of Health and Human Services, the oversight agency for all schools that do not report to ONR, conducted audits at 12 institutions and found \$14.1 million in unallowable charges. The individual bills ranged from \$4.8 million at Rutgers to less than \$33,000 at the University of Texas Southwestern Medical Center, and, according to the *Globe*, included such items as liquor, private golf club memberships, and flowers, chauffeurs, caterers, and gifts for the homes of college presidents.

Later that month, the Office of Management and Budget proposed a cap on one of the major components of the

indirect cost recovery rate—general administration—at 26 percent of the allowable base, effective October 1. The Institute's 1991 rate for general administration is 21 percent, so MIT is not one of the many institutions for whom the cap will mean a loss of government support. But the principle of an arbitrary cap that makes no allowances for different circumstances at each institution is a cause of great concern to the research establishment.

Interestingly enough, the entire Michigan congressional delegation, including Dingell, sent a letter urging the director of OMB to consider that an "immediate and inflexible cap" could cause "undue hardship for a number of research universities."

In their own defense, Kennedy and other Stanford officials have pointed out that the university had legal agreements with ONR covering many of the costs for which it was later pilloried. Other universities, including MIT, noted at the time that they returned government funds that they, too, were being held culpable on expenses that DCAA



Rep. John Dingell and his Subcommittee on Oversight and Investigations nailed Stanford for inappropriate charges added to its bills for research overhead, and then turned their attention to MIT and other universities.

auditors had been very comfortable with over the years. Auditors had no problem, for example, with the fact that MIT and other universities include a portion of the expenses of the president's house, which is routinely used for official meetings.

But the credibility of higher education was so tarnished by the well-documented yacht, cedar-lined closets, and antiques at Stanford, the golf club memberships that turned up elsewhere, and the liquor bills at many institutions, that the defense made little impression on the media or the public.

Even within their own communities, university administrators found communication on this issue to be heavy sledding. James Culliton, MIT vice-president for financial operations, prepared several articles for *Tech Talk*, trying to make the arcane calculations behind indirect costs a little clearer, and meetings were held with groups of faculty to answer questions. Considerations of morale aside, it was necessary to notify the campus community that the new federal auditing standards apply to the entire institution, not just to personnel and functions involved in research.

Some facts about MIT's situation: the Institute's indirect cost rate for fiscal 1990 was 62 percent, and the on-campus research volume totalled \$292 million. Of those funds spent on research in 1990, \$203 million covered direct costs, \$89 million went to indirect. A quick calculation shows that for every dollar that went directly to support research, 44 cents went to cover overhead and administration. So where does the 62 percent come from?

In fact, federal guidelines do not allow many of the line items included in the direct cost of research—such as equipment purchases and some subcontracts—to be included in the base on which indirect cost is calculated. In 1990, \$58 million of such direct costs were excluded, yielding a "modified total direct cost base" of \$145 million. Sixty-two percent of \$145 million is \$89 million, the total figure that the Office of Naval Research negotiators and MIT agreed would cover MIT's indirect costs associated with \$203 million in research volume. Keep in mind that regardless of the negotiated rate, the law requires a

university to document actual costs for government auditors.

(In fact, until the federal audit is complete, the books are still open. Understaffing at the Defense Contract Audit Agency left DCCA years behind in auditing, so in 1989, the agency and ONR launched a test program to speed things up by coordinating various federal, state, internal, and external audits. MIT is a test site, and James Culliton reports that the pilot program has been working well. But the audit of MIT's indirect costs for the fiscal years 1986 to 1990 was still not complete as of late August, which is why so many numbers

**MIT
refunding
\$781K is news;
saving the
government
\$8 million
is not.**

from past years were highlighted in the reports coming out since March.)

For 1986-90, \$3.2 billion dollars came into MIT for research on the campus and Lincoln Laboratory: \$2.7 billion in direct costs, \$482 million in recovered indirect costs. Of the \$482 million in indirect costs, \$778,000 was ultimately returned in April and May. The biggest chunk was \$400,000 to cover object code misclassifications and foreign travel. (Research-related overseas travel is an allowable expense, but only with prior authorization.) The remainder of the funds that MIT returned covered items that were not specifically mentioned in government regulations—in other words, items on which a judgment call was required at the time, and which new guidelines or hindsight now dictate are inappropriate. For example, in a directive issued in November 1990, OMB specifically disallowed charges for alcohol, and MIT applied that restriction to all the 1986-90 accounts retroactively.

Other charges MIT refunded to the government covered memberships in social organizations, catering, gifts and mementos, receptions, official functions at the president's house, and flower arrangements.

The \$778,000 was conspicuously mentioned in news reports, but an MIT Memorandum of Understanding that saved the government millions over the fiscal years 1988, '89, and '90 went unheralded off campus. In 1988, OMB, in an effort to hold the line, fixed the rate for one element within the general administration component—faculty contributions to departmental administration—at 3.6 percent of the modified total direct cost. For many universities, that rate represented a cut. MIT had a lower rate at the time, however, and implementing the 3.6 percent would have meant an immediate \$2 million windfall—an estimated \$8 million over three years. Knowing that the government's intention was cost containment, MIT opted to forgo the higher rate, and signed an MOU to that effect.

MIT moved quickly to respond to Dingell's April request that it review its books to find inappropriate charges. The administration reported that it is cooperating with auditors from Congress and DCAA, and has implemented changes in its accounting system and training of financial staff to meet the tightened federal standards of cost accounting.

Two points were emphasized in MIT's official statements about indirect costs. First: audit, negotiation, and return of mistaken charges are routine in university-government relations, and MIT always withholds funds for this purpose. And most important, MIT's concern was not so much with winning arguments over particular charges so much as preserving the health of the university-government collaboration in research.

The fact is, there still remain very serious debating points between MIT and the federal funding agencies, relating to libraries, graduate student tuition, NSF fellowships, and other topics central to the research enterprise. Flowers at the president's house are not among them. In a follow-up article, we will look at some of those issues. □

The Class of '66 "gettin' down" at the Armory Bash.



They Came, They Kicked up Their Heels



When 2,000 or more alumni/ae and their guests gather for the annual Technology Day luncheon, the story is usually predictable: lots of handshakes, conversation, and an outpouring of remarkable generosity for alma mater, with corresponding heartfelt thanks from its president.

But Charles Vest, who had been inaugurated as MIT's 15th president just three weeks before, made it a little different last June 7.

Perhaps even more than the millions in reunion gifts, said Vest, MIT—like the nation's other major research universities—this year needs the active and outspoken support and confidence of its alumni/ae.

There is a rising tide of skepticism about these world-class institutions—about the cost and quality of their teaching and research, their stewardship of public funds, and their fairness in managing student aid, Vest told his alumni/ae audience, that is “tending to turn people against us.”

Vest asserted that U.S. colleges and universities “will change what needs to be changed.” But he urged his audience—the largest group of alumni/ae he has yet met in his young presidency—to speak out on the greatness and immeasurable value of institutions such as MIT. “Carry with you the message—the quality of our students and the job our faculty is doing for them and for the world,” said Vest.

Christian J. Matthew '43, retiring president of the Alumni/ae Association, assured the president that the alumni/ae applauded his “willingness to assume national leadership in speaking out on significant issues” such as this.

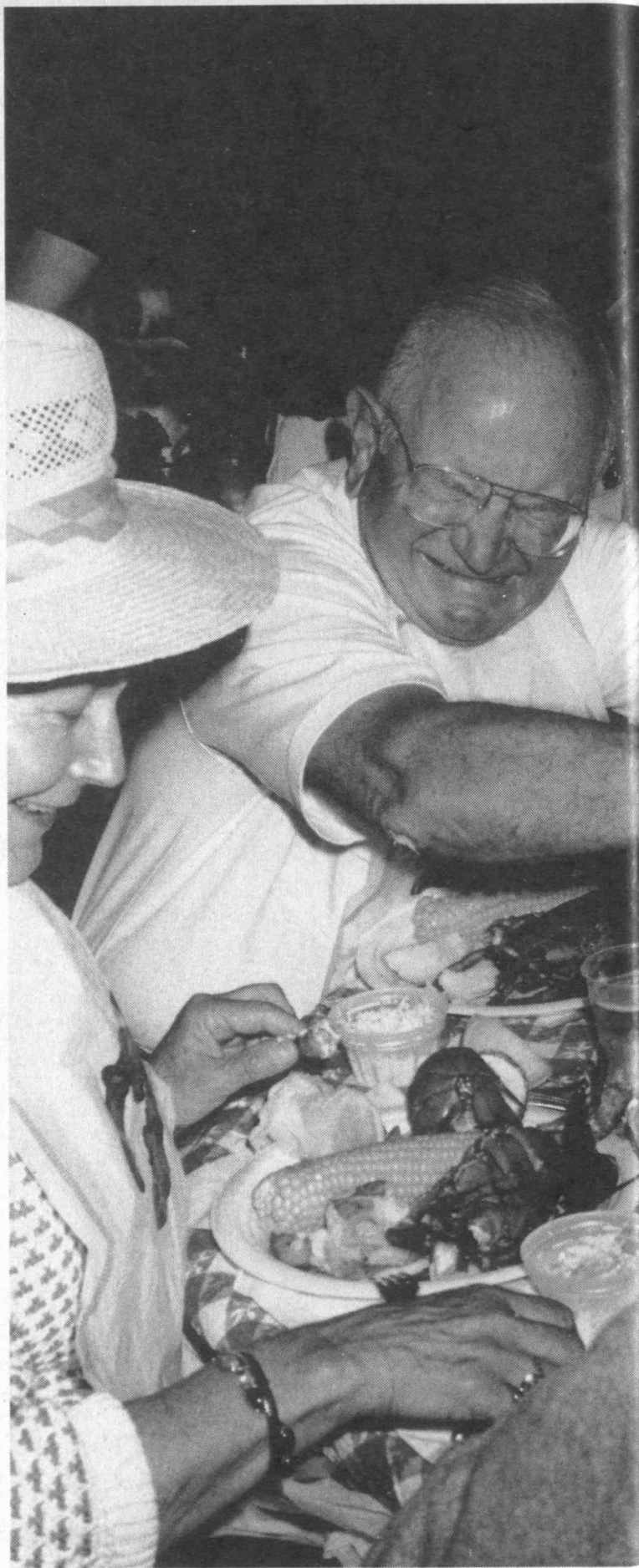
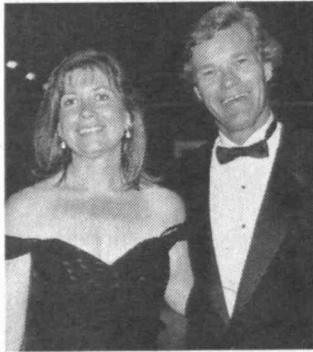
The Year's “Most Enjoyable” Task

At \$21.8 million, the total of 1991 reunion gifts and pledges from the Class of 1991 and the quinquennial reunion classes from 1926 to 1986 was outstanding by any standard, but particularly so in a recession year. In ad-

They Gave \$21.8 Million

REUNIONS '91

*Facing page: the Class of '71 set the stage for nostalgia by circulating a copy of *Technique* at their dinner at the MIT Museum. Right: Harold Glenzel, reunion chair for the Class of '51, knows as well as anybody that delicate nibbling has no place at a New England clam bake, this one at the beautiful Chatham Bars Inn on Cape Cod. Below, clockwise from top left: President of the Class of '61 Bennet Zarren and his wife Ellen joined classmates on a moonlight cruise on the *Spirit of Boston*; meanwhile, not far from the wharf, Reunion Chair Larry Schwoeri, his wife Mary, and confreres from the Class of '66 enjoyed dinner and dancing at Quincy Market; and Tech Night at the Pops—nuff said.*





dition, the 1991 Alumni/ae Fund was estimated to reach \$15 million by its closing on July 1, said Matthew, who presided at the luncheon as 1990-91 president of the Alumni/ae Association.

Vest was delighted, saying that receiving and responding to this display of tangible alumni/ae pride and confidence in the Institute was "the most meaningful and enjoyable task" in his first year's experience at MIT. "The sustained financial support represented by alumni/ae giving," he said, "is essential to the quality and independence of the Institute."

The reunion gifts were:

■ Seeking to "dismantle the barriers to good schools," the Class of 1991 pledged a fund of \$37,610 by 1996 to provide loan forgiveness to MIT graduates who go to work as full-time public school teachers.

■ Sharon Israel, president of the Class of 1986, announced a gift of \$19,080, nearly one-third of which was designated for the class's Student Aid Fund.

■ Marc Chelemer, reunion gift chair, reported \$37,111 in the Class of 1981's 10th reunion gift, of which \$19,907 was designated for student financial aid.

■ Just over 40 percent of the members of the Class of 1976 contributed a total of \$110,797. It was the second largest 15th-reunion gift ever recorded at MIT, according to Robert Lepkowski,

reunion gift chair, with 20 percent first-time donors.

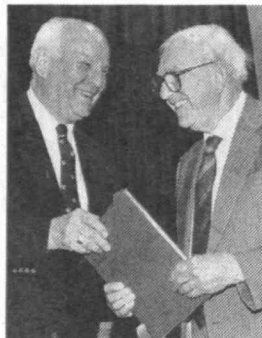
■ From the 25-year class of 1966 came a total of \$1,266,000. Paul Rudovsky, reunion gift chair, took special pride in reporting that a record 76 percent of the class participated. Of the total, \$175,000 was raised since September 1990 as a scholarship fund in honor of the late Professor Harold Edgerton, ScD '31.

■ Class President Bennett Zarren and William Hecht, executive vice-president of the Alumni/ae Association, led the Class of 1961 in pioneering a 30-year reunion gift to MIT; the total was \$675,720.

■ The Class of 1956's 35th reunion gift was another first at MIT, achieved under the leadership of Co-gift chairs Richard Jacobs and Harris Weinstein. The total was \$412,535 and included gifts from 46 percent of the class.

■ The Class of 1951 sent Gift Co-chairs William Maini, class president, and Marvin Grossman to the podium with a check for \$4,566,000 from 63 percent of its members. Of the total, \$702,000 was made up of alumni/ae gifts to the Class of '51 endowment for excellence in education pooled with matching funds from the Grace B. Kerr Fund.

■ Concluding one of the largest 50th reunions in MIT history, the Class of 1941 reported gifts totalling \$5.3 million from 66 percent of the class. Of that, said Joseph Gavin, reunion gift



Clockwise from top left: Chris Matthew, '43 (left), president of the Alumni/ae Association for 1990-91, had the happy task of presenting Nobel Prize-winning Economist Franco Modigliani with the certificate of his honorary membership in the Association; it may well have been 25 years since these members of the Class of '41 last sat in the garden of the President's House, where this year they enjoyed the hospitality of Charles and Becky Vest; Peter Saint Germain, '48, the 1991-92 president of the Association.

chair, \$332,000 was earmarked for studies on the impact of technology on society. "We have to pay more attention to the social issues," said Gavin. In addition, he said, 21 classmates said they had provided for future gifts to MIT estimated at more than \$2 million.

■ There was no argument with J. Kenneth Jamieson's assessment of his classmates as a "remarkable group." Their 60th reunion gift was \$2,964,762 from 77 percent of the class, the third highest 60-year gift ever recorded.

■ And for a spectacular finale, 93 percent of the living members of the Class of 1926 contributed a 65th reunion gift of \$6,429,000—the third highest reunion gift in MIT's entire history.

Honors for "the Godfather of Italian Alumni/ae"

When Professor Franco Modigliani of the Sloan School of Management was called to the podium by Matthew, he thought it was to receive an honorary membership in the Alumni/ae Association on behalf of the school's dean, Lester Thurow, who could not be present. Not quite, said Matthew; there were honorary memberships for both Modigliani and Thurow—to express the Association's thanks to both of them for their "tireless efforts" in

the service of alumni/ae activities everywhere. Indeed, said Matthew, Modigliani is "the godfather of Italian alumni/ae."

Modigliani responded with thanks of his own. Half his professional life—the most productive part of it—has been at MIT, he observed.

The luncheon followed a morning symposium on new developments in biology and medicine (see page MIT 5) that filled Kresge Auditorium, much to the credit of the both the panelists and the Technology Day Committee, chaired by George Clifford, '48. Some 1,100 graduates and their guests filled tables in the Johnson Athletic Center for the luncheon itself, and Matthew reported that more than 2,600 alumni were expected at one or more events of the annual reunion weekend. They came from throughout the U.S. and 22 foreign countries. The honors for long-distance travel went to Shantanu L. Kirloskar, '26, of Poona, India, and Max Seltzer, '18, was the only member of the oldest class represented.

To end the luncheon proceedings, Matthew introduced his successor as president of the Association, Peter M. Saint Germain, '48, who officially took office on July 1. —John Mattill □

The author is editor emeritus of Technology Review.



CLASS NOTES

15

I wish to extend cordial greetings and as always, I have really considered it a privilege to represent 1915, the CLASS SUPREME!

Years do fly by, and I guess the saying, "All good things come to an end" is somewhat fitting.

Joan Warren, daughter of **Robert A. Warren**, was kind indeed to call me and advise me of Bob's passing away on February 8, 1991. They were in Florida, and he had been having a problem with pneumonia.

I visited Bob and his daughter, Joan, at Weston, Mass., and Mattapoisett, after the 70th Reunion at MIT. Bob kept in touch with me and we always had such interesting conversations. He was born in Waltham and was 98 years old when he died in Jupiter, Fla.

After serving as an ensign in the U.S. Navy, during World War I, he became an economist for the Boston Federal Reserve. In 1926 he became president of American Airports of New England and New England Air Terminals. In 1929, he formed Claflin & Warren, an investment counseling firm. He joined Keystone Custodian Funds as director of research, retiring in 1957. In 1959, he became president of Fisher-Churchill Co. of Dedham, a family-owned company. He was chairman of the board of R.W. Redman Co. at the time of his death.

His interest in aviation began in 1909 when he built gliders and flew them off Prospect Hill. He and his father, the late George Frederick Warren, formed the Waltham Aeronautical Society, which led to a lifelong interest in aviation. He was a member of Early Birds of Aviation, Inc., an organization whose members had flown solo before 1916. He served as president of Early Birds in 1977-1978.

He leaves his three children, Joan of Weston, Margaret of Jupiter, Fla., and Robert of Norfolk, 10 grandchildren and 11 great-grandchildren.

I would personally like to add that he was a wonderful man, and I am delighted to have been acquainted with him and his family.

Another death I am reporting is **Benjamin Lapp**. A phone call from his son, Marshall Lapp, advised of his passing on March 23, 1991. His widow, Sophie, is still living. Ben and Sophie had been living in Fairlawn, N.J., but I visited them several times when they lived in Buffalo, N.Y., and was very pleased to consider them my friends. If and when I was in their neighborhood I made it a point to stop and say hello.

If anyone has information on 1915 classmates, please contact me. Thanks so very much for my being a part of 1915!—**Joyce E. Brado**, acting secretary, 491 Davison Rd., Apt. 9, Lockport, NY 14094

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Please send news for this column to: **Bob O'Brien**, acting secretary, 25 Keith Rd., Pocasset, MA 02559

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Phyl Severance and I just attended the annual "mini-reunion" of my class of 1938, and we were

reminded of the 1917 tradition of annual reunions. While other classes had their five-year reunions, as far as I know the classes of 1917 and 1938 were the only classes to reunion every year—in our case starting with the 41st. Now the organized "Cardinal and Gray" provides an opportunity for all classes graduated 50 or more years to convene together as a group every Alumni/ae Day weekend. Your class started something decades ago!

We were out of the country three weeks, and when we returned in early June I learned that **Ray Brooks** had had two bad falls. When we talked on the phone a few days later he was home from the hospital and with the aid of nurses and a walker was "learning to walk all over again." He has lost weight, and, as you know, his eyesight is almost nil. But he sounded in absolutely great spirits—as you would expect.

I've learned from the Alumni Office that **Ken Bell's** widow, Vera, died March 17. You may recall Ken passed away in 1970, a few months before their 50th wedding anniversary. Upon Ken's 1954 retirement from the vice-presidency of A.C. Laurence Leather Co., they moved to Melvin Village, N.H., on the shores of Lake Winnepesaukee. Vera was active to the last—even driving her car until she reached 88, and swimming until two years ago at the age of 91.

Do drop me a note about yourselves—or even call with any news.—**Don Severance**, acting secretary, 39 Hampshire Rd., Wellesley, MA 02181, (617) 237-9378

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The most exciting recent news was the annual Technology Day events, which I attended on June 7. You will recall that we expanded our class reunions to include the adjoining classes as our numbers decreased with the passing of time. Finally, we organized a joint reunion of all classes after the 50th reunion, now the Cardinal and Gray Society. I was much pleased to note at the annual alumni/ae meeting that there were ten tables seating about 100 graduates out more than 50 years. It made for great camaraderie—and made all of this group feel that we were not forgotten with time.

I received special recognition at this meeting and was asked to stand as the representative of the oldest class at the gathering.—**Max Seltzer**, secretary, 865 Central Ave., Needham, MA 02192

19

On page MIT 14 of the May/June *Review* is a picture of Vladimir Dixon, '21, with the headline, "Did You Know This Man?" After MIT, Vladimir attended Harvard for a master's in engineering. He worked for Singer in Paris, France, and died at age 29. Readers were asked to pass on any remembrances they had to his son in Washington, D.C. It just chances that **Don Way** and I both knew the family quite well, since Vladimir's father was manager of the Singer factory in Elizabethport, N.J., where Don and I were employed. We will respond by writing to the grandson. So now you know!

A while back I called three classmates on the telephone: **Douglas M. Burckett**, **George Cann**,

and **Ralph Cartwright**. Burckett evidently, was absent at the time, but Cann responded right away. He had a little cold, but we spoke plainly and enjoyed the short talk. He is now 94 years old and is blind but still has lots of spunk. Ralph Cartwright, now 93 years old, spoke with a firm voice and says he is still navigating. If you remember any of those men, I'm sure they would enjoy hearing from you.

Until our next notes, keep active and enjoy our world. With our best wishes, we remain, your class secretary—**W.O. Langille**, P.O. Box 144, Gladstone, N.J. 07934, (908) 234-0690

20

K.B. White died at his home, a castle, Chateau d'Arthies, at 95420 Magny-en-Vexim, France. His work as an efficiency engineer was widely known and respected. He was made a chevalier of the Legion of Honor.

Charlie Klingler died at his home in Milwaukee. He leaves his wife, Helen, and they established a foundation in his and her name with MIT as a principal beneficiary. Here are classmates that have contributed substantially to the reputation of our class and who are justifying our pride at being a member of the class of '20.—**Harold Bugbee**, secretary, 3 Rehabilitation Way, Country Club Heights, Apt. 313, Woburn, MA 01801

21

I have reports of three deaths: Mrs. **Lighton Evans** of Woodbury, N.J., in June 1970; **George Henry Atkinson** of Copley, Ohio, on January 27, 1991; and **Alfred C. Garrigus** of Attleboro, Mass., on March 31, 1991. Mr. Atkinson worked for Standard Oil in Boston for three years, then went to Chile in South America for nine years, then moved to Baltimore to work for Glidden, and finally to PPG in Barberton in their research lab for 20 years. Alfred Garrigus and his wife celebrated their 69th wedding anniversary last June. He was president of C.G. Garrigus Co., Haddon, Conn., for 44 years.

Alumni Fund envelopes brought in two bits of news. Helga (Mrs. **James**) **Parsons** wrote: "A token in memory of James S. Parsons and in appreciation of what MIT meant to him and continues to mean to me. I can't make it to the reunion." . . . **Benjamin Fisher** wrote that he and Mary moved this spring from Dedham to a retirement home in Walpole. "I worked 39 years for the Kendall Co. of Walpole. I think I can claim a class reward that I reached 86 years before acquiring a grandchild and now have four."

Class president **Cac Clarke** attended Technology Day weekend in Cambridge with his wife Maxine, son Alfred, and wife Marie. They took in the Boston Pops with John Williams conducting, and this particular program was recorded for future broadcasting on public TV. Cac also attended the service in the MIT Memorial Chapel and the sherry party for class secretaries. Anne and John Mattill, editor emeritus of the *Review*, were there, and the Mattills took the Clarkes to dinner Friday night at the Concord Inn. They met the new MIT president, Charles Vest, and also the former president, Paul Gray. At the MIT luncheon for all

classes, the 1921 table had (besides the Clarkes): **Roy Snyder**, **Benjamin Fisher**, and wife, and Mrs. **Harry Myers**. Altogether it was a wonderful weekend.—**Sumner Hayward**, secretary, Well-spring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel E. Lunden**, assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22 70th Reunion

Last May I attended the inauguration of MIT's 15th president, Charles M. Vest. Everything went off in accordance with plan. The morning weather looked dubious while the exercises were proceeding in Killian Court, but not a drop fell. The acoustics were excellent. Luncheon followed in Rockwell Cage. The ladies in attendance appreciated the cage's tiled floor, a great improvement over the dirt cinders they had to put up with before the Athletic Center was built.

Present from the Class of '21 at Technology Day in June were **Aline** and **Ray Ellis**, **Marjorie Pierce**, and your secretary. Without success I looked for **Bertha Dodge** and **Saul Coppelman** both of whom were listed on the bulletin board as probables. The attendance of alumni/ae who have passed their 65th reunion and were therefore guests of the Alumni/ae Association at the luncheon was negligible, a total of 17 from classes 1915 to 1925. The Association can stop worrying about a possible flood of free riders.

Your secretary spent the rest of the weekend at Andover enjoying the annual Alumni Day there, where the Old Guard (those past their 65th and four years younger than the 65th at Tech) are guests of the school for three full days. Probably I am prejudiced, but I must say that I think Andover has the finest campus of any prep school. If anyone knows of a better one, please advise.

Frederick H. Untiedt, 91, died in Chevy Chase, Md., last January 11. I have a vague recollection that Fred was the inventor of (or at least had something important to do with the invention of) foam rubber. He is survived by his widow and a daughter, **Ruth Untiedt Hare**.—**Yardley Chittick**, secretary, Rt. 1, Box 390, Ossipee, NH 03864

23

In a continuation of a warm winter in southern Connecticut, spring has been early with temperatures of over 90 degrees and a dose of humidity, the latter usually being more unbearable than the actual temperature. But we in New England grin and bear it.

With reference to another area, an account has been set up in preparation for our 70th reunion. It seems a little early but, as noted before, there are preliminary expenses to be taken care of. (My Braintree High School teacher taught me never to end a sentence in a preposition.) Several checks have already come in.

We recently had our regular summer visit from **Miriam** and **Dave Joy**. Winnie and I took them for a ride around a series of reservoirs in the Metropolitan District of Hartford ending with a lunch of lobsters at the Log Cabin on Route 44 east of Winsted. These reservoirs are exceptionally well kept in park condition in the hills of West Hartford.

Marcia K. McNutt, a noted geophysicist with experience in oceanographic research, has been named the Griswold Professor in earth, atmospheric, and planetary sciences at MIT. The Griswold Professorship was established in 1987 with a bequest from our late classmate, **Earle A. Griswold**, who died in 1986. Professor McNutt has made 10 oceanographic expeditions from Scripps, Woods Hole Oceanographic Institution, Lamont-Doherty Geological Observatory, and Oregon State University. She was co-chief scientist on the Crossgrain 2 expedition to the Marquesas Islands in 1987. In connection with her ocean research, she completed special U.S. Navy and Seal Team training courses in underwater

demolition and explosives handling. In 1988, Professor McNutt received the American Geophysical Union's Macelwane Award, which recognizes outstanding contributions to geophysical research by young scientists. She has also been elected a fellow of the American Geophysical Union and presently chairs the committee that oversees the publication of all the Union's journals.

Two deaths of classmates are sadly reported. **Neil Alexander MacNeil** died April 10, 1991. He was born in 1899 in Grand Narrows, Nova Scotia. He received an AB degree at the University of St. Francis Xavier of Antigonish, Nova Scotia, and a SB in mining engineering and metallurgy in our class at MIT. At the Institute, Neil was a member of the Catholic Club, British Empire Club, and the hockey team. He married **Rhea Champagne** of Holyoke, Mass., and they had four children and four grandchildren. Following graduation from the Institute, he was employed at the U.S. Metal Refining Co. of Carteret, N.J., Pittsburgh Crucible Steel Company of Midland, Pa., Holcomb Steel Co. of Syracuse, N.Y., U.S. Steel Co. of Worcester, Mass., and Waltham Watch Co., all in metallurgy capacities. In 1935, he joined the Springfield Armory and became products superintendent until his retirement. At the armory, he assisted in the development of metallurgical techniques of the Garand rifle, asserted by General Patton to be "the finest weapon in the world."

The death of **Ephraim Fletcher Ingals**, a member of the class, has recently been reported. He died January 5, 1990. He was born in 1889 in Chicago, Ill. He prepared at the University of Chicago and received an SB in business and engineering administration at the Institute. While at MIT, he was a member of the Rifle Club, Corporation XV, Aeronautical Engineering Society, and treasurer of Delta Upsilon fraternity. He married **Barbara Barnes** of Boston, Mass., and they had one son and two grandchildren. He served in the U.S. Army becoming a captain in the Air Corps. In 1948 he served as assistant superintendent in the Airport Branch of the Civil Aeronautical Administration. His hobby was boating.

We send condolences to the families.—**Frederick O.A. Almquist**, secretary/treasurer, 63 Wells Farm Dr., Wethersfield, CT 06109

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It is sad to report that a very active member of the class of '24 has passed away. **G. Donald Fife**, on April 15, 1991. He was our class reunion chairman and performed many other helpful class-related jobs. He leaves a wife, three sons, and seven grandchildren. His address was RR 1, Box 296, Eastham, MA 02642. This information was sent by **Col. Stern**. Our condolences go out to the entire family. . . . A query letter from Alumni Records was sent to the family of **Victor C. Smith** of 32556 Mound Rd., Apt. 5, Warren, MI 48092. It was sad to learn that he died February 7, 1991. There were no next of kin.

My mail has been sadly lacking in notes or letters from you alumni/ae. Thus you'll have to hear about my visit to my grandson in upper New York State—months long and simply precious.—Co-secretaries: **Katty Hereford**, Box 5297, Carmel, CA 93921; **Col. I. Henry Stern**, 2840 S. Ocean, 514, Palm Beach, FL 33480

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Elinor and **Sam Spiker** and **Courtenay Worthington** attended the inauguration of Dr. Vest and had lunch together in the Rockwell Cage. Court has received a letter from **Wen Tsan Chang** in Shanghai. He wrote regarding the grandson of an old friend and schoolmate **C.Y. Chou**, '24, who is graduating from Beijing Information Technology Institute and wishes to attend MIT. Court was able to get the Admissions Office to send materials to the young man. . . . A note from **Bill Her-**

bert states that he is active in a number of programs, religious and civil, and is looking forward to the 1995 reunion.

The passing of three classmates must be reported. **Chester P. Currier** died at his home in Worcester, Mass., on March 31, 1991. Chester was an engineer and designer in the machine tool division of the Norton Co. for 30 years before retiring in 1964. He leaves his wife **Elizabeth (Hines) Currier**, a son and two daughters, 10 grandchildren, and three great-grandchildren.

Edward H. de Coningh died at his home in Shaker Heights, Ohio, on May 5, 1991. He was partner, chief engineer, and chairman of Mueller Electric Co. and a leader in health and welfare activities. He was a former chairman of United Appeal and president of the Welfare Federation for three years. Ed was a trustee of Case Western Reserve University, the Cleveland Institute of Music, and Smith College. He leaves his wife **Martha**, two daughters and a son, nine grandchildren, and six great-grandchildren.

Ronald A. Mitchell died on May 29, 1991, at Johnson Memorial Hospital in Stafford Springs, Conn. He was considered a civic leader in this town. Mitch was president of the former **Cyril Johnson Woolen Co.** for 35 years. He also was a warden of the borough of Stafford Springs from 1935 to 1941, a former member of the school board, a chairman of the board of directors of the Stafford Savings Bank for 50 years, a trustee of the Connecticut Public Expenditure Council, and a board member of Connecticut Bank and Trust. He leaves a sister, a daughter, three sons, and seven grandchildren.—**F. Leroy (Doc) Foster**, secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

26

Our 65th Reunion had 23 members sign up to come—the lucky ones with their wives. The greatest distance traveled was from Poona, India. **Shantanu Kifloska** has been to almost all of our reunions. I was there for the reunion, but at the Pops Concert I left the hall and upon returning didn't notice there was a change in floor levels, as I have only one fairly good eye and there was no paint to warn. I fell and have been using a cane as I damaged my right leg. I ended up coming home Friday morning, missing the remainder of events and meetings with classmates.

I found a letter from **Juan T. Villanueva** of the Philippines, responding to **Eliza Dame** too late for the 60th Reunion book. He included notice of honors received, and also a considerable story of his life. Juan must have been a great help to people in that part of the world. If you wish a copy of his resume to include in your 60th Reunion book, write to **Eliza Dame**, MIT Alumni/ae Association, 10-140, MIT, Cambridge, MA 02139.

Henry C. Rickard has moved to the Foxhill Retirement Home, 10 Longwood Dr., Westwood, MA 02090, (617) 320-9112. He says, "On behalf of those of us who sneak in a secret shut-eye during some afternoons, a special salute to **Tom Green** for courageously bringing the subject of naps out-of-the-closet. Classmates, frankly, enjoy your naps—but wake up for supper." **Thomas D. Green** writes that his wife **Natalie** died April 17. The newspaper article enclosed showed that he had a great girl, as I had, and his loss will be as great as mine. She leaves two sons, a daughter, grandchildren and great-grandchildren. Thomas' advise to young men is "don't get old."

Edward N. Roberts of Florida, died August 9, 1990, leaving a daughter. Edward was a consulting engineer at E.I. DuPont de Nemours & Co. There was no write-up. . . . **Morris L. Minsk** of Chelsea, Mass., died March 13, 1991. He never married. A patent examiner at the U.S. Patent Office, Washington, D.C., Morris and I had many phone conversations. You may remember that he took in one of the Cardinal and Gray affairs in Dedham, in a wheelchair. He sent my wife a beautiful bouquet of silk flowers when she was in

the hospital. It is now on my desk. . . . Mrs. Louise Taylor of Phoenix, Ariz., wife of **William Taylor**, died February 2, 1991. William died July 18, 1989. She left a daughter, Nancy. . . . **Louis F. Clark** of Los Angeles, Calif., died March 8, 1991, leaving as his only relative, a brother. He was a staff engineer for Pacific Tel & Tel Co., San Francisco. There was no write-up in the 60th Reunion book. . . . There is no doubt, our class has done a lot for the U.S.A. and other parts of the world.—**Donald S. Cunningham**, secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

27 65th Reunion

Your secretary and Phyllis enjoyed Technology Day and the fascinating lectures presented by the competent men of the Biology Department. **Dick Hawkins** joined us at the luncheon. Our class has a big challenge: to meet 1926's reunion gift to MIT at our reunion next year. Dick is very proud of his sailboat.

Larry Grew was visited in May by Alice Donald, widow of **John K. Donald**, who died in 1972. Larry and John roomed together after graduation when they worked for SNE and AT&T in New Haven. He was best man for Larry in 1931. Alice has also visited **William Tucker**, who retired from RCA Camden and now lives in the San Diego area.

We regret to report four deaths this month (notices all received from their widows). **Leroy G. Miller** (civil engineer) of Rockbridge, Ohio, died on January 30, 1991. His wife, Mildred, writes: "There is a bequest to MIT in his will. He was very proud of his association with MIT." . . . **Maurice C. Holmes** of Homestead, Fla., died on March 16, 1991. He received his doctorate at MIT in 1927. He was professor emeritus of physics and engineering at the University of Miami, where he helped establish the College of Engineering. He was a distinguished member of the President's Council at the University of Florida. Maurice was listed in the roster of *American Men of Science* for his work in the practical applications of the theories of mathematical probability. His work ranged from high frequency electrical circuitry to fluctuations of stock prices on the New York Stock Exchange. As vice-president for a New York brokerage firm, he wrote articles for *Barrons* and the *Wall Street Journal*. His widow, Frances, survives him.

William F. Fitzgerald of Montclair, N.J., died on April 8, 1991. He was formerly assistant vice-president of Consolidated Edison Co. in New York City. He served in the Air Force as a major during World War II. He is survived by his widow, Lois. . . . His widow, Ruth, notified us that **Edmund H. Burke** of Newburyport, Mass., died on March 19, 1991. He graduated as an architect, but we have no further information about him. . . . We express our deep sympathy to the widows and families of these classmates.—**Joseph C. Burley**, secretary, Isle of Springs, ME 04549; **Lawrence B. Grew**, assistant secretary, 21 Yowago Ave., Branford, CT 06405

28

Even though our 65th Reunion has seemed like something for the future rather than the present, it will be down to only a year and a half away when you receive this October issue. We have had a few messages on this subject, from **James White**, **Gabriel Disario**, **Bettie (Chester) Day** (who has already enlisted their son Chester Jr., '56, to escort her) and **George Palo**. Thoughts expressed have been varied and it is too early for analysis. But firm decisions will have to be made soon and it is hoped that many more, regardless of expectation of attendance, will reply in order to function to the benefit and satisfaction of all. Our past reunions have been exemplary. If we do have this as our last get-together, it should be

equally so.

We are most fortunate in having **Florence Smith** working with us on class matters. She has been pleased to hear from many, following **Walter's** death, including information for class notes. **Gabriel Disario**, from Caracas, Venezuela, has been involved in the formation of an MIT Association for the 200 MIT Alumni/ae in Venezuela and expressed hope for our 65th. Florence also had a call from **Eleanor Pepper** who is still an active architect and teacher in New York. Congratulations to her for her long career in architectural engineering as we do not hear of many of our class who are still professionally active.

Miriam and **Clifford Terry** are still continuing their hobby of worldwide travel. Though a trip to South America was cancelled due to cholera there, they re-scheduled for Scandinavia and Russia with a bonus jaunt to Hawaii for the total eclipse on July 11, 1991. . . . Our Class Agent **George Palo** and wife Anne spent an active month back in their Tennessee territory and other stops included Civil War battlefields before returning to Minnesota.

We congratulate **Elisha (Bud) Gray** on his recognition in the July *Technology Review* "Donor's Profile" for his participation in the MIT Life Income Funds Program with a gift to the Maclaurin Pooled Income Fund. His business career started with Sears Roebuck and continued through the formation and operation of the Whirlpool Corp. with extensive accomplishments in civic and Institute activities.

Florence Smith represented the Cardinal and Gray Society, which headed the alumni/ae in the academic procession at the Inauguration of President Vest. **Florence** and **Ralph Jope's** granddaughter, **Beth**, presented the Jope Cup to a Harvard crew at the E.A.R.C. Regatta on Quin-sigamond, in conjunction with a Jope Family Reunion.

Unfortunately, there are more deaths to be brought to your attention. **Frederick Lewis** died on April 20, 1991, at a Veterans Administration Medical Center. His career, other than World War II service, was with Exxon Co. After retirement he was with Artisan Industries for 15 years along with many other MIT and '28 engineers. . . . **Hector Hagedorn** died on April 10, 1991, in Madrid, Spain, after an illustrious lifetime in engineering and government service. Coming to MIT from Manila, The Philippines, he was on many post-World War II commissions in the Pacific, engineering bridges and buildings, and ending with the building of U.S. airports in Spain.

An item of unfinished business is the election of a replacement for our late president **Walter Smith**. **George Palo** (Class Agent) has suggested that he, along with **Hermon Swartz** (Reunion Chairman), **Florence Smith**, and **Ernest Knight** (Secretary), as the currently active members, continue with their duties pending appropriate action on the matter in time for or at our reunion in 1993. Your concurrence is assumed.—**Ernest H. Knight**, secretary, Box 98, Raymond, ME 04071, (207) 655-4231

29

Eric A. Bianchi of Taquesta (Jupiter) Fla., sends a note: "Helen and I again spent a very pleasant three months this summer in Grantham, N.H., and plan to do the same in 1991. Our health seems to be good, so we continue to enjoy golf and gardening. Helen does the planning, and I get the privilege of executing." . . . **Edward R. Godfrey, Jr.** of Huntington, N.Y., writes, "My dear wife, Gladys, has become quite frail, and I am happy to be well and strong enough to care for her which is a full-time job." . . . **Edward H. Perkins**, 85, of Ipswich, Mass., writes, "This last year I have failed quite a bit. I now have a pacemaker to jog my lazy heart, and it really helps. This year, I am master of my Masonic Lodge in Georgetown, Mass., where I used to live. I am now living in our summer cottage at

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the shore, which we bought in 1956 and have gradually made into a winterized home. High tide is 100 feet away, and winter storms are beautiful to watch. I still have my sailboat for the summer, but not for long, as I am beginning to lose my sense of balance." Ed has been heading the U.S. Power Squadron in that region for many years.

Frank M. Mead of Marion, Mass., and Northgate, Fla., writes: "Having reached my 84th year, my pattern of living is changing, particularly when I lost my dear wife, Mary. I do a lot of gardening, flowers and vegetables, in Marion and play golf four times a week in both places. I go to Florida in early September—my neighbors are just arriving, so I will continue to be active. Karnig, you are great doing such an effective job as our class secretary." . . . **Louis F. Southerland, Jr.** (wife Jean) of Austin, Tex., writes, "My wife and I enjoyed celebrating our 50th wedding anniversary in January in Mexico where we had spent our honeymoon. We were joined by a number of friends for a beautiful celebration and a banquet. I plan to go to Victoria, Canada, this summer for a week of watercolor painting. Later in the fall, I will be doing the same in Guatemala. Retirement life brings a great deal of pleasure to me and my wife. . . . Having read about our auto accident of last Christmas in this column, **Paul S. Baker** (wife Kay), of Williamsburg, Va., sends a note of get well wishes, which is greatly appreciated. I am happy to report that my wife, who received the full impact of the collision, is fully recovered from her injuries. We are thankful that God was merciful to spare her life as well as mine."

A note comes from **Jonathan F. McCray** and wife, Isabel, of Bel Air, Md.: "I became involved in Tax Aid, helping elderly couples to file their income taxes as I used to do in Huber Springs, Ark. It is a great satisfaction to be able to help people. I plan to continue as long as I am able to. One of the volunteers in the Tax Aid group, the moderator of the Round Table discussion group of great books, invited me to participate, starting last September, at Hartford Community College. The first book for discussion was *Plato's Crito*, which I enjoyed very much. It has been a number of years since I first read it. Glad to hear that you recently have a great-granddaughter. I was a member of the Baltimore Girl Scouts Council for a number of years before we returned to Arkansas, and I have a soft spot for little girls."

I regret to have to report two deaths: **George J. Guthrie Nicholson, Jr.** of Thermopolis, Wyo., on April 2, 1991; and Pauline, wife of the late **Dexter Osgood** of Malverne, N.Y. Our class agent for a number of years, **George Nicholson** was employed by the Consolidated Edison Corp. in New York from 1930 to 1948. He interrupted his work there to serve as a naval officer in the South Pacific in World War II from 1942 to 1945. In 1948, he moved to Newport and worked for Newport Electric Corp. and then Eppley Lab in Newport. He was working a degaussing station at the Newport Naval Base when he retired. He was a member of the American Institute of Electric Engineers and an honorary telephone pioneer. He leaves a son, George James Guthrie Nicholson III, of Atlanta, Ga., two daughters, a sister, and six grandchildren.—**Karnig S. Dinjian**, secretary, P.O. Box 83, Arlington, MA 02174, (617) 643-8364 or (603) 926-5363

30

By the time these Notes appear, the inauguration of Charles Vest as MIT's 15th president will have been fully reported in the *Review*. **Jack Latham** was kind enough to send me a copy of the impressive brochure that was prepared for this occasion, along with a note saying that he was the only member of the Class of '30 who attended. . . . **Reg Bisson** reports that he is physically fit after triple-bypass heart surgery about two years ago. He keeps busy attending Rotary Club meetings and Laconia Savings Bank trustee's meetings,

as well as keeping up with the antics of the two youngest of the Bisson's six grandchildren. Reg sent me a 1931 photo showing him precariously perched atop the Waldorf-Astoria building, then under construction in New York. He notes that 60 years later he gets dizzy standing on a two-foot step-stool. . . . **Bill Waite** also reports "good recovery" from major surgery a couple of years ago. Last April he became a 50-year member of the American Institute of Chemical Engineers, although he has built "no oil refineries or chemical plants for the past 20 years." He and his wife Peg visit Montpelier, Vt., every few months where they enjoy dancing at the senior center.

Angelo Ricciardelli's day starts with a morning jog (which he characterizes as his octogenarian shuffle) for about a mile. Other activities include attending a class on Italian Literature at the University of Virginia, monitoring FNN for investment opportunities, reading three newspapers and recording for the blind. . . . **Willard Morain** reports that he had a daughter and son-in-law who served in Operation Desert Storm in Dhahran, Saudi Arabia. He still swims daily in a YMCA pool and has now passed the 2,500-mile mark. He is secretary-treasurer of the Mt. Vernon, Ohio, Amateur Radio Club, treasurer of the Coin Club, and collects guns, militaria, coins, watches and iron toys. . . . As previously reported, **Frank Nettleton** worked for many years at the New Haven, Conn., headquarters of the Southern N.E. Telephone Co. and retired in 1968 as General Plant Supervisor. After retirement he became involved in banking and served a few years as chairman of a First Federal Savings and Loan Assoc., then fully retired. Frank notes that he and his wife Eleanor have attended all five-year reunions of the Class of '30. The Nettletons now live in a life-care community in Essex, Conn., where there are six of seven MIT grads who meet now and then and recall old times.—**Gordon K. Lister**, secretary, 294-B Heritage Village, Southbury, CT 06488

31

Back from our 60th Reunion—a really grand affair—from Wednesday evening June 5 through Saturday evening June 8, which meant most of us did not leave McCormick Hall until Sunday morning, June 9.

The Committee for the reunion really did an outstanding job—between the lectures and our travels around Cambridge and Boston. These included a guided bus ride around Boston where we were told what MIT architects and engineers had designed which buildings (like going through a deep canyon with walls of glass instead of three to five story buildings—we had a hard time determining just where we were, the structures were so different); a visit to the Boston Art Museum and its exhibition of paintings "Pleasures of Paris: Daumier to Picasso," the Boston Harbor Hotel with its view of the Harbor, and best of all, to the Boston Museum of Science, whose Mugar Omni Theater presentation of "The Blue Planet" made you feel as though you were on the airship taking the photographs.

Of the meals which came along with our stay and visits, particularly memorable was that engendered by **Polly Germeshausen** at the Grier Building on Vassar Street (a lobster dinner—and though I have known lobsters all my life, the shell on mine was the heaviest I have ever known). All were excellent and really more than we needed at our age and activity. When I arrived home I found I had put back the eight pounds I had just lost, but had a lot of work to do in my garden so have now lost it again.

One unusual occurrence—when **John Harrison** reported at McCormick Hall on the 6th to register, he suffered a heart attack and was shipped off to Mt. Auburn Hospital where he was placed in intensive care with no visitors. Fortunately one of our classmates, **Lou Green**, is an M.D., and he managed to get by the "no visitors"

ban and found John was really starting to snap back and was quite cheerful. I called John's house in Durham, N.H., on June 21st to find out how he was doing, and was more than surprised to be greeted by his fiesty voice. He reported that he had had a number of attacks since 1966 and had recovered from each of them. He had been sent home from this one in ten days. . . . We also were introduced to our new President, Charles Vest, and his wife Rebecca (Becky) and two children, and they seem to be settling in after their migration from the University of Michigan. (I missed my own 55th Reunion at that Law School—it came on exactly the same day as ours in Cambridge).

We had a rather informal class meeting at our dinner at Grier. **Randy Binner** was unanimously reelected president. **John Swanton** retired from his position as class agent and the job was foisted onto **Ed Hubbard**. No one volunteered for the jobs of treasurer or secretary, so the current incumbents, **Ben Steverman** and yours truly, are in for another term. **Priscilla Gray** was elected an honorary member of the class.

Thirty-four class members, 28 guests (wives and widows) and four others registered by 9:30 AM on the 7th.

Shortly before Reunion I was advised that **Ed Worden** had returned to the nursing home and later received a call that he had passed away on the 15th of May. Since then I have received a short obit written by Helen, which follows.

"Edwin Sheldon Worden, 83, packaging consultant, died Wednesday, May 15, at the Lake Eustis Care Center. He was born in New York City, February 29, 1908.

"After graduating from MIT, Ed received his MBA from New York University in 1940. He was partner and president of Edwin S. Worden Associates. He served as Principal Supply Specialist from 1943-1945 and was the recipient of the Commendation Medal for Meritorious Civilian Service from the War Department. He was a member of the American Society of Testing Materials, Packaging Institute.

"Mr. Worden moved to Tangerine, Fla., from Westport, Conn., in 1976 and was a member of the Tangerine Community Church. He was also a member of the Mount Dora Yacht Club, the Mount Dora Lawn Bowling Club, the Ocala Power Squadron, Elks Eustis Lodge No. 1578, past member of the Mount Dora Kiwanis Club, and member of the Quarter Century Wireless Association."

*They have taken their bright candles and have gone
Into another room we cannot find
But everyone may know where they have been
By all the lovely lights they left behind.*

Author not known.

He is survived by his wife, Helen G., a daughter, and one granddaughter.

Ben Steverman, our busy treasurer, has received dues from many of us and information about what some of you are doing. **Leo Green** was one of them. He and his wife Mary attended our reunion as I had mentioned, staying with their daughter in Newton. He is an orthopedic surgeon but finally gave up surgery in 1989 when the malpractice insurance premiums reached \$90,000. As he expressed it he "Didn't want to become a target for lawyers." Even though I was a lawyer and practiced for 50 years, I never sued a physician for any sort of malpractice—which is not to say that I never became a "Target for Doctors." I was in 1926, when I had only been at Tech for five weeks, and besides losing my appendix, also lost a year at Tech, for my uncle, a doctor, would not let me come back for 30 days, and only then "if you are very careful."

Art Lappin sent Ben a letter with his dues. He and Mae are in reasonably good health in Sarasota, quite active, enjoying the "ideal" weather there and while they hoped they could make the reunion, they did not. . . . **Al Kuhn** in Santa Rosa, Calif., advised that he and his wife Eleanor would be unable to attend though the tone of it indicated he would like to be here.

Ben was particularly pleased with the response to his bill for dues. He had received them from 73 of us and a total of \$2,434, plus notes from some for other gifts to MIT.

Clara and Ben were unable to stay for Technology Day and Saturday. His March 14th operation (aneurysm on the aorta) while a great success still left him a bit shaky—but very happy he could be there as long as he was—from my observation he looked good.—**Wyman Boynton**, secretary, 668 Middle St., Portsmouth, NH 03801, (603) 436-1309

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60th Reunion

Technology Day last June was a beautiful summer day. The following members of our class attended part or all of the activities: **William Bannon**, **Wendell Bearce**, **Don Brookfield**, **Melvin Castleman**, **Majorie Fuller**, **Francis Gowen**, **Harry Johnson**, **Douglas Miller**, **John Northup**, **Albert O'Neill**, **Herber Uhlig**, and **Thomas Weston**.

The symposium on "Sex, Drugs, Genes, and Obesity" was extremely interesting and very well presented. Be sure to read about it in the alumni/ae section of this issue.

There was a fine memorial service at the MIT Chapel for all MIT alumni/ae who died in the past year. Our departed classmates were listed as follows: **Giles W. Anderson**, **John F. Bradley**, **J. Paul Breden**, **John T. Calvert**, **Howard F. Carver**, **Robert G. Cunningham**, **Ivanhoe P. Denysen**, **Gertrude E. Deutsch**, **Henry S. Duncan**, **Joseph D. Eisler**, **William A. Hall**, **M. Holmes Hartshorne**, **Irving W. Hilliard**, **Warren S. Little**, **Harold G. Mangelsdorf**, **Eugene B. McBride**, **José D. Murga**, **Samuel G. Nordlinger**, **Thomas W. Regan**, **John P. Serrallach**, **George H. Sherwood**, **Clarence W. Stacey**, **George T. Weed**, **Edwin R. Wilkinson**, **Edgar B. Wright**.

Our class president conducted a class meeting on Friday afternoon that was attended by most of our Technology Day participants. **William Pearce**, our treasurer, was unable to attend because his wife, Midge, is recovering from an accident. He reports that we have over \$2,500 in our treasury. . . **Arthur Marshall** had three heart attacks but is recovering nicely from his quadruple bypass. He sends his greetings to classmates and thanks you for the many good wishes he received. He will serve on our 60th reunion committee. It won't be long before you will receive more specific information about the reunion. Prepare! **Francis Gowen** accepted the chairmanship of the nominating committee for 1992.

Kenneth W. Smith writes, "My wife, Betty, (Wheelock '33) is a victim of Alzheimer's disease and is in the John Knox Village Care Center in Lee's Summit, Mo. I am in good health at 82 years of age, in an apartment, and active in music, golf, and volunteer work. I enjoyed the *Review* February/March 1991 article on "New Technologies for Fighting Brain Disease." I hear frequently from my Phi Sigma Kappa fraternity brothers. Best wishes to all."

Working on the telephone for the Alumni/ae Association, I had the opportunity to talk to some of our classmates. **John "Jack" Parker** misses his wife's cooking, so he has taken up cooking as a hobby. He has just returned from Vancouver where he grew up. He has four grandchildren whom he enjoys very much. His health is good although he has a bit of difficulty walking. . . **Melvin Gelin** lives in Florida, likes to travel, and watches the stock market. He has two children and six grandchildren who keeps him occupied. . . **Alfred Mulliken** retired in 1975 and lives in Florida. He likes golf and is active at the Whiskey Creek Country Club. He has four children and eight grandchildren scattered over the U.S.

We received information that **Giles Anderson** died in England on February 19, 1991. When we have more obituary information, we will pass it on.—**Melvin Castleman**, secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Robert C. Rogers reports from 414 Lawrence Ave., Westfield, NJ 07090: "I'm a spectator now—watching the world go by from the confines of the garden and golf course. Household chores, a dog, and a few hobbies keep me busy." . . . **Mort Williams**, Course X, keeps in "desultory touch" with **Clare Farr** and **Bob Smith**, as well as with several classmates in Florida. He also managed to attend two mini-reunions recently. His address is: **Mortimer P.**, 1309 Jefferson Ave., Pasadena, TX 77502. . . **John C. King**, 101 East 252nd St., Cleveland, OH 44132, writes: "Married **Freddie Zimmerman**, a beautiful lady, last September. Thanks to her, I feel 20 years younger than the eight decades I survived this February."

Frances (Polly) Varney Marshall (Mrs. Edward W.), 10 Crescent St., Weston, MA 02193 should like to be included in the list of "ladies of our class still with us." Mr. Marshall, Harvard '26, recently attended his 65th. Mrs. Marshall had attended Vassar prior to MIT.

Other ladies who statistically appear in the record and may still be extant—**Gertrud Ebbson**, Mrs. Peter (Margaret B.) Geddes, Mrs. Arch (Katherine) McNeil, Mrs. Seymour (Alice) Smith. If anyone knows of any of these people, please communicate with me.

Obits: Robert Dillon, deceased November 11, 1990. Mrs. Dillon lives at 1402 Crockett Dr. W., La Marque, TX 77568. We have no further details. . . **George Green**, Course X, April 14, 1991. Mr. Green was a lieutenant Colonel in World War II, commanding a chemical mortar battalion in the Pacific. He was a member of Temple Emanuel in Worcester and former master, Level Masonic Lodge and Occidental Masonic Lodge in Stockbridge. Mrs. Green had predeceased him. . . We learned that **Hazel Weld Curtis**, Course IV, died of Alzheimer's within the past few years, from Mrs. Evelyn Killam Hoar, '34, 32 Cumberland Ave., Verona, NJ 07044.—**William B. Klee**, secretary, Box 7725, Hilton Head Island, SC 29938

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John Hrones sent the following reunion report: "Classmates attending the annual alumni/ae day luncheon were **Hank Backenstoss**, **Ted Rimbach**, **Barbara** and **Bob Roulston**, **Carl Wilson**, and myself. Hank is recovering from recent medical treatment and doing well. His daughter Martine is a practicing MD in France. Bob and Barbara spend summers on Lake Sunapee, N.H., and winters in Ocala, Fla. Ted Rimbach is in St. Louis and still active professionally. Carl and Molly spend their winters in Coronado, Calif. My son John Jr., class of 1968, and my daughter Janet Roach were my guests at the luncheon. Janet was in Cambridge to attend her 30th reunion at Radcliff."

Jim Eder writes that he found that **Wilton Lindsey** has been living in the same town of Chapel Hill for the last five years. Wilton lost his wife a year ago, so he's in an oversized apartment in Carol Woods, a fine retirement center. Wilton and Jim were in Course II. They both share interest in furniture. Wilton still makes furniture even though he lives in the retirement center. Jim quit furniture when he sold his family's 400-man furniture factory in Colombia, South America in 1964. (The new owners have since run it into the ground and it no longer exists.)

But to get back to Wilton; he sold his Florida residence last winter, but still has a time-share condo at Sanibel Island, Fla. His one child, a daughter, is a professor in the religious studies program at the University of Tennessee (Knoxville). She had gotten a PhD at Harvard. Wilton enjoys life where he is and busies himself with gardening and furniture making. His only news of MIT comes from the class notes. The paucity of news shows that our classmates are semi-illiterates, meaning they can still read, but they can't write. Jim would have looked up Wilton five

years ago had he read of the move in the class notes.

Gordon Burns writes, "Dot and I just returned from a short trip to see our daughter Janet and her husband in Miami, where they have started their own business of computer consultation, hardware, and software for architects and civil and mechanical design engineering firms. While there I took a tumble and broke my right wrist, with the result that my arm is in a cast. We then went to Savannah to an annual get-together with fraternity brothers and wives. Among them were **Natalie** and **Sam Brown** and **Mary** and **Jim Eder**. Much of my spare time goes into a paper study of a somewhat unconventional approach to fusion power—not "cold fusion." I'm trying to devise equations to put on my computer, to see if this approach has any merit. When brain gag sets in, I shift gears and help Dot with her crossword puzzle." . . . **Warren Kunz** wrote some time ago from Deltaville, Va., that he and Iona often take two-week cruises on their boat, but also longer trips. Thus, their friends are "boat people," but no exactly Vietnamese. Their oldest son graduated 29 years ago from MIT and then from the Sloan School; their youngest works at IBM near Wappingers Falls, N.Y. The class notes do not allow mention of grandchildren, fearing fierce and unbridled competition.

Hank Backenstoss writes that he was looking forward to the marriage of his daughter, Martine. However, it did not happen. This editor wonders if Martine's early years in Beirut had any impact. She knew Arabic and tumultuous Middle East culture. Hank also says he accepted a real challenge, that of the presidency of the Foundation for the Reading Public Museum and Art Gallery. It's a big job, even for Hank. He has to raise \$1.2 million every year to replace the funds formerly supplied by the public school system. In addition, Hank has the problem of who should run the museum, the political school board or a group of prominent citizens interested in the museum. The museum was created when Reading was the full-fashioned stocking capital of the world. Good luck Hank!—**Robert Franklin**, secretary, P.O. Box 1147, Brewster, MA 02631; **George Bull**, assistant secretary, 4601 N. Park Ave., Chevy Chase, MD 20815

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I received a note from **George Dunlap** through the Alumni/ae Office: "Wife Grace and I are still going strong. Spend summers in Rand, Colorado (Elev. 9,000 ft.). We had a welcome visit from Otto Zwanzig and wife. Otto and I worked together at General Electric in Course VI-A." . . . A note also arrived from **John S. (Jack) Holley** in Chula Vista, Calif.: "Hi, y'all. In a little over a year I'll be an 'Octo.' Hope the same for you. My bunch, Course XIV, only had eight members, of whom three have departed the planet, so a big 'hello' to **Jake Castleman**, **Bob Spinney**, 'Goldy' **Goldthwaite** and 'Butch' **T.K. Graham** and anyone passing through is urged to stop by." . . . A note from **W. Whitney (Whit) Stueck** from Satellite Beach, Fla., says: "Retired and living in Fla. Wife is disabled with rheumatoid arthritis so travel and activities are restricted." . . . **Lester A. (Les) Brooks** wrote from Rockmart, Ga.: "I may get out to see you yet and resume our rivalry on the links. A third party asked me to meet with these people (Fairfield Chemical) in San Antonio last March to discuss rubber chemicals for a few hours. I'm going to quit consulting after this year—I'm running out of steam." Les went on to say that if any follow-up develops on this contract, he'll be flying in to San Diego and will knock on my door.

Art Haskins came through with his first "Christmas Letter" written in May; it's the first one since Dorothy passed away in January 1990. In the summer of 1990 Art says, "my Tanzer 22, Surefire, and her crew came just short of the top in local racing. We took second place in the Tan-

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zer 22 State of Maine Championships and also in the Casco Bay Interclub Regatta in our class, both two-day events. However, we spent so many Saturdays competing unsuccessfully in other races in the Casco Bay area, that we didn't make out in the point standings in our own club Saturday series. At any rate, the boat work will soon get underway in earnest, just as soon as a few home and church chores get done." Art went on to say he is literally the Chief Cook and Bottle Washer with son Dan as Chief Engineer at his ranch. Last December he and Dan went to Colorado to visit his daughter Carolyn and husband, Wayne Roth. They stayed through Christmas and went on to visit his brother Don in Tucson where the temperature was a balmy 65 compared with 20 below in Boulder. And now back in Bath, Maine, the grass is growing and has to be cut.

Walter H. (Stocky) Stockmayer arrived on schedule for his meeting in San Diego and we got together for a brunch at the Torrey Pines Golf Club on Sunday, May 19. I learned that he still has not climbed all of the 4,000-ft. peaks in the White Mountains yet, but will. On the weekend of September 21st I am taking a short trip to MIT. More on that later.

I regret having to report the deaths of two more of our classmates: **John H. Best** died April 17th and **Oscar F. Wiedman** died March 24th. The only information I have on John Best came from the Alumni/ae Association which had a telephone conversation with Philip Best, John's son. John was living in Punta Gorda, Fla., and his wife, Betty, is currently institutionalized with Alzheimer's Disease. From his 50th reunion notes: John had three sons and a daughter and he spent the major period of life with Bendix Corp., in Baltimore, and retired as chief engineer of the R&D department in 1983. . . . **Oscar Wiedman** died at the Elmwood Medical Center in New Orleans. He retired from the American Cyanamid Co., after 38 years, as vice-president. He received the key to the city of New Orleans from former Mayor Victor Schiro for his "contributions to environmentally safe industrial development." His survivors include two daughters, six grandchildren, and two great-grandchildren. You are doing better on those cards and letters, please keep them coming, especially those from Course XIV. **Tom Graham**, who used to row with me years ago, tell me what you have been doing the last 56 years!—**Allan Q. Mowatt**, secretary, 715 N. Broadway #257, Escondido, CA 92025; (619) 432-6446 will take a three-minute message.

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With our 55th reunion just ended we hasten to record the aura, using words written on the spot by **Peg Thornton**: "Friends who have known each other for almost 60 years never look old to one another. The two images of youth and later age meld in our eyes to form a vital picture"; and "some of the most glorious weather known to man or woman. . . . All were glad they had come, and glad that 1936 had produced so many durable, very attractive, and friendly people, led by **Alice Kimball**." Also, "The names of '36ers unable to attend were not forgotten." Queries about missing Ables, Bakers, or Charlies usually found answers from someone present. Alice of course was elected president for another five-year term; **Ken Arnold** was voted vice-president, replacing **Ed Dashefsky** who declined due to his health, and **Eli Grossman**, **Henry Lippitt**, **Pat Patterson**, and I continue in our respective jobs.

We have a plethora of individual news items from the reunion to report, and much carry-over from the last issue. So please bear with us for the finish of San Francisco Bay Area visits, and by winter the glow of reunion will still be around.

When I called **Bill Hewlett** at home to arrange a visit, he begged off because he had just taken his wife to the hospital, and it was not a con-

venient time. So I posed two questions over the telephone: What was the genesis of the Hewlett-Packard endeavor, and when did they sense their forthcoming success? He answered the first in a few minutes, started on the second, and then suggested that I call at H-P headquarters to see a three-hour documentary videotape he and Dave Packard made in 1983. In a word, success was complicated—the typical ups and downs of many budding businesses, but magnified by World War II upheavals and rapid developments in electronics. At war's end sales plunged 50 percent by the end of 1946, and the necessary adjustments were painful. Nevertheless they hired some bright engineers, developed new products, and sales doubled from 1950 to 1951. Doubling again in 1952 brought the sweet smell of success.

As to genesis, the H-P partnership (incorporation in 1947 did not change their modus operandi) was a product of their association and training at Stanford University in electrical engineering, and particularly the urging of Professor Frederick Terman that they become entrepreneurs. Bill Hewlett came to the Institute for one year to get an MS in 1936, while Dave was in the G.E. Test Program in Schenectady. Bill had another Tech contact at the end of the war, when his Army Signal Corps orders put him on an intelligence team headed by President Karl Compton. (Some readers of this column may have had dealings with Bill in business or the military.)

Bill made crystal radios while in high school or earlier, and tried his hand at a Tesla coil and an electric furnace. Dave was interested in "wireless" even in grade school, and got a ham radio license while in high school. They met as Stanford freshmen. So in 1939 when they set up for business in Palo Alto in a one-car garage, it was the culmination of years of dabbling in electricity and radio, formal training, and the will to get-up-and-go. Their first product was a low-frequency variable oscillator that Bill had developed. It became a staple of the business. **Art Jaeger** had favorable experience with this product. At retirement some 40 years later Bill and Dave could say the business was well enough organized to get along without them and, "It has been fun." This reminds me of Doc Edgerton, who also came to MIT as a graduate student. Doc's formula, quoted in the *Boston Globe* at his death last year: "Work like hell, tell everyone everything you know, close a deal with a handshake, and have fun."

John Myers and **Jeanne** very graciously made me their guest for two nights, and **Boris Maximoff** for one. They were all so accommodating that my late arrivals (once after 11:00 at night) were taken without a stir. California hospitality is exceptional. John was Course XVI and he took another year at the Institute, getting an MS in engineering economics. Thereafter, he alternately had financial management assignments at United Air Lines and Lockheed, and did Army duty in World War II and in the Philadelphia district during Korea. He finished with Ampex. Two years in New Guinea were a military high point. As captain of an AA battery that he had organized and trained stateside, he knew every one of the 240 men by name (twice the normal number of men). Each level of his unit participated in choosing his subordinate officers. Result: such competence and esprit that the battery "practically ran itself." The tribute to **Jim Grove** in April '91 Notes recalled to John a big green Cadillac convertible phaeton that Jim drove back and forth from the Fenway to the Institute, loaded with Chi Phis happy for the ride over the bridge. John was a Fenway neighbor in Phi Gam.

Fred Meyer, one of **Bill Rousseau's** cordon of Course X-A Practice School supporters, retired as a vice-president of Bechtel Corp. after a coronary attack in 1966. Now in good health, Fred plays golf and the market. After getting a BS at the University of California in 1933 and working at Standard Oil, he met a summer hire from MIT and was impressed with his "ability to handle things." So he applied for a X-A fellowship, won it, and drove cross-country with three other stu-

dents in a Model A Ford. One of his practice school assignments was with a Bangor paper mill in 1936, and there he met Jennie. After only three dates, he had to court by correspondence from California, but he succeeded. Her lunch for Fred and me attested to a long and happy marriage.

A trip up to Oakville in the Napa Valley to see Al Horton was delightful. He has had two strokes, has considerable difficulty getting about, and his left arm is weak. But his spirits are good and his memory better than ever. Al was with Chevron Chemical from 1939 until his retirement in 1976 as foreign vice-president. In the 1960s and 1970s he was on an advisory committee with Bill Hewlett for India's fertilizer project, and made 16 trips to that country. Al was also a director of Coromandel, which produced 13 different fertilizers. On this April afternoon, wife Gabrielle drove Al and me through part of the beautiful valley and to visit the Mondavi winery which buys their acres of grapes. Then back to the home for dinner with friends Joan and Larry McEwen (class of 1940). At about 9 PM, after much fine dining, wining, and conversation, Larry mentioned in some other connection "the three years Al worked for President Compton at the Institute." Huh? Gabrielle said she thought we all knew about that. Not me! But I had a two-hour drive back to Redwood City, so Al promised to write about it. Now at hand, the letter relates: "My first job after graduation from MIT was that of Assistant to the President. I trust the following will fill the gap about an eventful time in my life." In what follows there is much of interest, and it should not be briefed. So please hang in here for the next issue, except: In 1941, Al married Gabrielle, who he had met on a double date with Scott Rethorst. Al was on leave from Chevron for work on a wartime engineering training program. On one of many trips to Washington for consultation with the government and military, President Compton called to visit Al and Gabrielle, and they entertained him for dinner.

On my way to reunion I spent parts of three days visiting classmates along the southwest portion of Route 128, with interesting results—in future Notes. But on one visit I was too late: Ronald Eames (Course XV) died March 20 of a sudden bout with cancer, but his wife Marie's report had yet to reach me. I found her at home, striving for composure, and rightly very proud of her husband's career: Ron worked in technical writing and other communications for Raytheon, retiring as publications manager. He lectured on technical writing at Rensselaer Polytech in the late 1950s. At Raytheon he knew Leo Kramer and Ken Swain. Ron was MIT-oriented early: his father David was '06, and his uncle Jesse J. Eames, '02, was a Tech professor. After retirement Ron himself worked for the Institute in 1981-82 preparing material for Congressional hearings on energy conservation. On May 16, 1991, the town meeting of Weston adopted a resolution expressing "deep gratitude for the 25 years of unselfish service" on the Board of Appeals and earlier on the Library Expansion Committee. "Ron was the essence of decency, fair, open-minded, and very conscientious. His kindness and generosity, fed by a sincere religious life, extended in many and various ways beyond Weston."

From a Newport News clipping comes word of the May 14 death of Gordon Donnan (Course XIII) who retired after many years with Newport News Shipbuilding. He came to the Institute from Thayer Academy and University of Alabama. At Tech he was in Quadrangle Club and won his letter in four years of track. No family survivors were named, and a cousin could not be reached. Gordon's home as an undergraduate was in Wollaston, Mass.

Philip Grant, who was with us in Course XV and finished at Worcester Poly, died March 17 in Portland, Maine. After a brief stint with SD Warren Co. in Portland, he joined Union Mutual Insurance Co. He retired as senior vice-president in

the early 1970s. Wife Lillian died in 1988. He had been battling cancer for a few years, but died of heart arrest. His son Hamilton related "he just went to sleep beside me as I was driving the car." A friend's reaction to the news was "what a nice man—never a negative word." Cheers for the lives of Ronald, Gordon, and Philip!—Frank L. Phillips, secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; James F. Patterson, assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

37 55th Reunion

Phil Peters and Wait Wojtczak represented the class of 1937 in the inaugural procession for the new president of MIT, Charles M. Vest. Class members in attendance at Alumni/ae Day were Win Comley, Hobby Hobson, Dave McLellan, Mel Prohl, Bob Thorson, Len Seder, Roger Wingate, Walt Wojtczak, and Bill Wold. The program on "Sex, Drugs, Genes, and Obesity" at Technology Day was outstanding.

All indications are that we should have a fine attendance at our 55th reunion at Newport, R.I., on June 1-3, 1992. Make your plans now!

Walt Wojtczak is president of the Southwest Florida MIT Club. Walt and his wife, June, spend their summers at Newbury, N.H. . . . Win Comley is secretary of the New Hampshire Southeast Regional Refuse Disposal District. He plays golf at the Wentworth-by-the-Sea Golf Club and does some gardening. Win retired from Stone & Webster Engineering Corp. in 1984. . . . Received word that Joe Keithley (founder of Keithley Industries, Inc.) and his wife, Nancy, have endowed a chair in technology management at Weatherhead, part of Case Western Reserve Institute.

Norm Matthews retired 11 years ago and his last position was as physical scientist, U.S. Bureau of Mines. He does light farming, church work, and volunteers at the local hospital. He had an operation in January but is now in good health. Norm winters in Florida at a home bought jointly with his younger son.

Hank Stern can't believe it is birthday 75. (The same feeling that comes over many of us! However, when you attend Alumni/ae Day, you see that MIT men are very active and still going strong.) Hank had quadruple bypass heart surgery in October 1990, recovered excellently, and is feeling better than for years. He's doing exercises, gardening, reading and enjoying retirement with his wife Dorothy. He intends to work on his golf game and be ready for the 55th reunion. . . .

Charles Gadd retired in 1976 as senior engineer, research laboratories, General Motors. He was supervisor of automatic safety. Chuck lectures and has written articles in journals world-wide devoted to violins and other stringed instruments. He has received various awards for violins and violas.

Virg Vaughan, Jr., retired in 1980 as director of computer communications of AT&T and still is active as consultant. He received a Doctor of Science degree in 1982 from Randolph Macon College. After retirement from AT&T, the Department of State sent him behind the iron curtain and to other places (Africa) where he had never been. He suggests that the group who got their BS in 1937 and MS in 1938 (Course VI-A) should get together at the 55th reunion. Virg lives at 69 Elmwood Ave., Chatham, NJ 07928. . . . Fred Altman retired in December 1988 as senior scientist from CyberCom. He likes hiking, square dancing, and traveling. He's working on building good, cheap, polyhedron models and wondered if any of our class had done this. Fred lives at 1020 North Quincy #213, Arlington, VA 22201. . . .

Bernard Ross earned MD and PhD degrees from the University of Chicago. He is a self-employed physician and has published two books, *The Fundamental Pathway to Better Health* and *Niacin Can Curb Craving for Alcohol*. He's now Visiting Adjunct Professor in the Department of Mathematics

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at the University of South Florida.

My compliments to the class for your great response to our request for news for the class notes. Keep it up!

Now comes the difficult part of the job of class secretary, reporting the deaths of our class members. **John Pitkin** died on February 15, 1991, after a long bout with Parkinson's Disease. . . . Recently notified of the death of **John C. Gibbs** on May 11, 1989. John was retired from Nevada Power Co. as executive vice-president. His wife, Jeanne, lives at 3204 Skipworth Dr., Las Vegas, NV 89107. John left six children and 16 grandchildren. . . . **Leo Rosen** passed away on March 16, 1991. He was former assistant director of the National Security Agency and a former leader in U.S. Intelligence. Leo was a pioneer in the development of 20th century cryptology. He leaves two sons and four grandchildren.

It is with great personal sorrow that I report the unexpected death of my good friend **John H. Fellouris** on June 11, 1991. John was our Fund Class Agent for many years. He received a master's degree from the Illinois Institute of Technology. He was the founder and president of the John H. Fellouris Construction Co. of New Bedford, Mass., and its manager for 25 years before he sold the business in 1981. John was the resident director for the Greek War Relief Program that constructed hospitals and health care centers throughout Greece and its islands. He is survived by his wife, Peggy (who lives at 1290 Rockdale Ave., New Bedford, MA 02740), four daughters, two step-daughters, and seven grandchildren.—**Robert H. Thorson**, secretary, 66 Swan Rd., Winchester, MA 01890

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Our annual Endicott House mini-reunion following T-Day included the **Norm Bedfords**, **Gretchen Birge** (all the way from California), the **Lou Bruneaus**, **Paul Des Jardins**, the **Frank Gardners**, **John Glacken** and **Frances Roche**, **Haskell Gordon**, the **Hadleys**, the **Horace Homers**, the **Bob Johnsons**, **Norm Leventhal**, the **Sol Kaufmans**, the **Frank Kemps**, **Fred Kolb**, **Dave Morse**, the **Paul O'Connells**, **John Petroskas**, the **Severances**, the **Dave Wadleighs**, and the **Al Wilsons**.

Although some "regulars" at the last minute couldn't make it, several returned from extensive trips just in time to attend. You will be hearing more about our 55th reunion in 1993, but we should add that we already have reservations for mini-reunions of 1992 and 1994. Hold all those three early June dates!

We knew **Ruth** and **Frank Kemp** would surely be at our reunion. What we hadn't realized was that Frank in early March had undergone a double bypass. What a difference it has made in his lifestyle. He had to begin exercising—something he had successfully avoided these past 50 years. . . . **Sylvia** and **Sol Kaufman** had just returned from a trip to Israel. They visited with their son and daughter-in-law who live there. Howard is a lawyer in his own practice and his wife, Laura, is a dentist. Their other two sons live in the Boston area with their wives and children. Their three grandsons, of course, give them much joy and pleasure. . . . **Madelyn** and **Paul Des Jardins** made what has become their annual visit to France for the month of March. It included an El-dorhostel which covered a week on the Riviera at the University of Nice, a week in the central part of France in Lyon, and a week at the Sorbonne. They followed this by a week on their own in Paris and Chantilly.

The **Bob Johnsons** had a good winter in Sarasota: good health, climate, friends, and some contact with MIT alumni at meetings of the MIT Club of Southwest Florida—a sizable and active group. Travels last fall included 12 days and much history in England, from Stonehenge to Hastings, plus Bath, Brighton, and London. . . . **Frank Gardner** reported that he and "E" enjoyed two weeks in March, trading the snows of New

Hampshire for the warmth and sun of California and Arizona. They will return to visit a National Park or two, especially the Grand Canyon which they missed because of a blizzard. Frank's interest in protecting the environment continues with emphasis on preserving the lakes. This last year he ventured into tracking the State legislature with the N.H. Lakes Legislative Coalition. . . . **Muriel Leventhal** was unable to join Norm at our reunion for she was participating in a worldwide bridge contest. To you other bridge enthusiasts, a word of warning. Don't trifle with Muriel at the bridge table. We have just learned that congratulations are indeed in order. On June 7, the day of our reunion, Muriel was awarded a certificate as a Heat Winner of the 1991 Epson Worldwide Bridge contest, sponsored by the World Bridge Federation.

Norm rarely discloses anything about his roles on behalf of MIT and the community, and now and then we pass along information we've picked up in the press. I suspect we never did mention how his Boston Harbor Hotel celebrated its opening about four years ago. Actually it was to open sans fanfare. But its neighbor, the New England Aquarium figured this new hotel would be a far better site for an Aquarium benefit party than a wind-swept tent behind their own facility. So on Saturday in late November 1987, Norm's new hotel sponsored the Aquarium gala. The party was sold out (at \$300 a head) before the invitations even hit the mails.

Your secretary, having urged others to share their experiences, thinks it's probably time I do as much. The end of January, two years after an arthroscopic operation on a knee, I had a total replacement of the same knee. To celebrate, Phyl and I took a three-week trip to Scandinavia. Besides visiting **Bergin**, **Oslo**, and **Copenhagen**, we spent 12 days and 2,500 miles round trip on the Norwegian Coastal Express which serves 35 Norwegian coastal towns from **Bergin** around the North Cape to within ten miles of the Soviet border. It stops at ports each way, carrying round-trip passengers, like us, and taking on and discharging mail, transient passengers, and freight ranging from automobiles to fresh fruit. Six days were above the Arctic Circle where at the end of May we often resorted to ski underwear and down jackets.

Fred Kolb and an associate of Eastman Kodak last March were honored by the Academy of Motion Picture Arts and Sciences. They received its Academy Technical Achievement Certificate in recognition of "accomplishments which contribute to the progress of the industry." Fred is quite modest about this which was a direct application of his chemical engineering. Years ago, everyone in the field knew that strange things happen when 35 mm film is projected with a 25-100 kW light source as a result of the strong thermal expansion forces. The industry needed to be able to anticipate and plot the resultant contour changes. Fred and his partner designed the test film now used internationally for this purpose.

Our prexy, **Horace Homer**, reported on our Class of '38 Scholarship Fund and an especially gracious note he had received personally from one of the recipients. **Fred Kolb** thoughtfully offered to prepare the following summary of the significance of our scholarship gifts and how they are administered.

"The Class of 1938 Scholarship Fund 'made a difference for my family and me'—said **Charlie Choi** this spring in a letter of thanks to Homer, our class president. Charlie is a junior (class of '93) whose family got pinched financially ('my father was withdrawing money from his retirement fund to survive') so that an award from our fund will make it possible for Charlie to continue at the Institute!

"The Class of 1938 Scholarship Fund now totals over four million, and its income is one of the resources available to the Institute's Financial Aid Director to meet just such needs.

"Financial Aid at MIT is based solely on need. Ability to keep up with the class is proof positive

of scholastic preparation and ability! (And as we know personally, MIT does not have any athletic scholarships or 'Golden Sibling' awards!)

"MIT makes a careful analysis to define 'need.' Students and family together prepare the financial aid application with questions about the student's possible assets, and the family's ability to contribute. In addition, parents submit a Financial Aid Form to the College Scholarship Service in Princeton (the same submission serves most of the U.S. colleges, and the parents specify who gets copies). We do our own recalculation, being particularly sensitive to obligations toward other children and dependents, and thus derive our estimate of a reasonable and equitable family contribution. The total of student and family contributions defines the student's resources. We know the costs. The difference is provided by Financial Aid!

"Financial Aid comes in three parts: (1) a job on campus for 10-15 hours per week during the school year (guaranteed if the student wants it!), (2) a loan to the student as a part of the student's investment in the future, and (3) a scholarship grant to make up the required difference! The sum of (1) and (2), however students choose to allocate it, this year is \$5,700, and is the first and required part of every package. MIT, through numerous benefactors, is then able with its grants to provide the difference and so balance the account for every matriculating student!

"From applicants for admission, the request for financial aid sits untouched in their folder, until the Admissions Committee decides to whom admission will be offered. Then parents are asked for a copy of their most recent IRS filing, and the Financial Aid Committee springs into action.

"For upperclass students, the Financial Aid Committee asks each year for an update on family circumstances, and makes a new determination of need for the coming year. We work very hard to see that every student is able to complete the Institute program!

"Currently 54 percent of our students receive financial aid, with the median values being: Family Contribution \$6,700, Self-help \$5,700, Scholarship Grant, \$9,450. (And each year, there are a few students whose family's resources are so meager, the family's ability to contribute is nearly zero.)"

It seems we must always conclude on a sad note. We are indebted to **Lawrence Peterson**, '36, of Schenectady for the news of the death of one of his former associates and a well-known classmate of ours, **Bob Treat**. Bob died last February in Mesa, Ariz., following a long illness. Bob had entered MIT from Schenectady, was active on campus, graduating in chemical engineering. Following six years with Goodyear Tire and Rubber in Akron, he returned to Schenectady, joining GE in its infant silicon program. He continued in the silicone products department for 37 years, retiring in 1981. He was active in Scouting, past president of the United Cerebral Palsy Association, and an elder and deacon of the Union Presbyterian Church. Services were held in Arizona and locally in Schenectady.—**Don Severance**, secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley**, assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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Seymour Sheinkopf writes: "Sylvia and I attended the investiture of **Charles Vest** as 15th president of MIT last May 10. Also representing our class were **Jim Barton** and **Mary Oz Stewart** and **Lucille George Beesley** and **Eleanor and Chuck Mercer** and **Louise**. On the evening preceding the investiture, we enjoyed a bountiful reception and then an inaugural concert at Kresge Auditorium. The concert ended with a performance of the MIT Festival Jazz Ensemble that brought the house down. **Martin Lindenberg** and **Mary** joined us at luncheon the next day in Rockwell Cage."

Clint Lawry relayed a newsclipping from the Institute of Electrical and Electronic Engineers reporting a new honor to former IEEE President **Harold Chestnut**. He received the 1990 Richard M. Emberson Award for "Leadership and dedication to the Institute's technical growth and service worldwide, and for development of systems engineering concepts." Clint says, "It is a little-known fact that Harold probably saved my life years ago. With other MIT students, we climbed Mt. Khatadin in Maine. As we were descending from the famous Knife Edge, a flu bug caused distress and I was unable to continue descent. In spite of my protestations, Harold chose to stay with me until I recovered enough to make it all the way down. If he hadn't stayed, I believe I would not have survived." Clint and Faith Lawry celebrated their 50th wedding anniversary during a week in Bermuda.

Hewett H. Phillips, distinguished research associate at NASA Langley, was honored by election to the National Academy of Engineering. . . . **Mike Herasimchuk** and **Jean** make regular contributions to this column from their experiences with the International Executive Services Corps. Recently, they went to Alexandria, Egypt, where Mike consulted on a project that applied computer technology to optimize income from a business and its associated farm/ranch. After returning to the U.S., Mike underwent heart bypass surgery, convalesced quickly, and was golfing within six weeks. By request of department heads at MIT, the Course III-XIX funds raised by Mike, **Morrie Nicholson**, and '39er metallurgy alumni/ae and well-wishers was authorized to be applied to scholarship and loan aid to MIT students in those courses.

Bill Murphy and **Anne** enjoy retirement from their Clearwater, Fla., base. Bill says his golf score increases, and they mitigate the pain by trips to oversee U.S. property interests and vacation trips to Europe and Hawaii.

John Alexander and **Nancy** and **Hilda** and I attended another great barbershop chorus and quartet concert in Seattle. Next day, after breakfast including hotcakes plus real maple syrup from New England, we were treated to the maiden-voyage cruise around Lake Washington on the Alexanders' new 24-foot cabin cruiser.

Meredith C. Wardle writes: "Still hibernating in the deep north (Nome, Alaska). June retired from teaching and is researching visual acuity effects on reading problems in Eskimo children. I am eager to re-launch *Born Free*, our cruising sailboat. We plan more cruising between here and Puget Sound."—**Hal Seykota**, secretary, 1701 Weatherswood Dr., NW, Gig Harbor, WA 98335

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Class treasurer **Richard Babish** sent me a copy of a letter he sent to class president **Norman Klivans** in which he discussed upcoming mailings regarding the possible reunion in Naples, Fla., in January 1993, and the annual dues billing to go out in the fall of this year. I am sure you are all anxiously awaiting the latter, so you can send in your checks by return mail.

Dick also included a copy of a letter from the conservator of **Bodger Wright**, in which she reported that he was well enough in February to move from a Skilled Care Nursing Home to a Resident Care Home, where he is very comfortable and happy. She said that he would be pleased to receive mail from any classmates. His address is: Westgate Villa, 5425 Mayme Avenue, San Jose, CA 95129, (408) 366-6510. Dick also mentioned a letter he received from Sue, wife of **M. Loren Wood**, indicating that Loren has a similar, but less serious situation than Bodger. But both men expressed their optimism by sending in dues for the next five years!

I am sorry to report the unexpected death on March 21, 1991, of **Otto F.A. Arnold**. The New Bedford (Mass.) *Standard Times* reported that he

was an electrical engineer who designed facilities for area radio stations, and was a founder of New Bedford radio station WBSM. Otto graduated from Peekskill (N.Y.) Military Academy, and then from MIT with a degree in electrical engineering. Soon after graduation, he was in charge of the design and construction of a new transmitter for New Bedford station WNBH. Following World War II military service, he designed and built other radio facilities, and installed the first experimental facsimile radio transmission system in the northeast. It was used to deliver a reduced size morning newspaper to several homes. From 1965 until his retirement in 1982, Otto worked at MITRE Corp., where he managed designs of command control communications related to Air Force programs. Among his other activities, Otto was a member of the Governor's Defense Council, The Governor's Emergency Energy Committee, New Bedford Girl Scouts finance committee, United Fund, and Mattapoisett and Fairhaven Improvement Associations. For his activities in England with the Air Defense Research and Development Establishment on Radar, he received a special commendation from the Army Signal Corps. And to round off his very active life, Otto served as a counselor with SCORE, the Service Corps of Retired Executives. The class extends its sympathy to his family.

Hyman Freedman writes from Canandaigua, N.Y., that he was in Cambridge for Alumni/ae Day on June 7. The only classmate he saw was **James Baird**. Hy enclosed an article from *The Retired Officer Magazine* of April 1991 making reference to **Roy Brown**. Hy recognized a wartime picture of Roy with a group of other members of "Watson's Whizzers." This group, according to the article, collected advanced German aircraft, immediately after the end of the war in Europe, to utilize them in shortening the development cycle for United States planes. Among others, they acquired a number of very early model jet trainers—the forerunners of today's planes. The article mentions Roy's part in this venture, and some of the exciting experiences the group had flying the planes in and out of airfields around Europe. After seeing the story, Hy wrote to Roy, their first contact since graduation, and reminisced about grinding a telescope mirror together in the basement of Hy's home. In his reply, Roy noted that he has attended reunions every five years. He also commented about the magazine article.

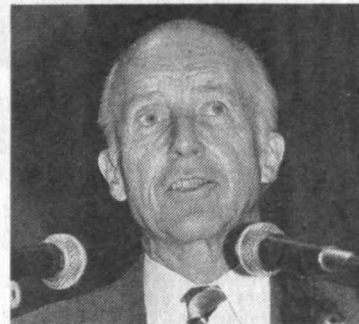
It's great to receive mail like that. I hope other class members will do the same. Send the correspondence to **Richard E. Gladstone**, secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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June 1991, our 50th reunion, has come and gone! Six hundred five freshmen registered in 1937. *Technique* 1941 pictured 480 seniors; 543, including transfers, received SB degrees in June 1941. Five hundred seventy-six affiliated with our class after graduation, and we now have 401 living members with known addresses. Of these, 128 classmates (perhaps 245 including spouses and guests) registered for at least one event of a wonderful reunion week arranged by chairman **John Sexton** and his 50th Reunion Committee.

Most of us marched in the academic procession into Killian Court, feeling very grand, but solemn in our red coats and freshman ties. It was hard to remember that in 1941 at Symphony Hall, class of 1891 marchers could have fought in the Spanish American War and their fathers in the Civil War. Those of us who marched out after the impressive 1991 ceremony got a rousing hand from the new graduates who were probably whispering, "They go back to World War III!"

After a brief reception at Eastman Court, the majority, box lunch in hand, left by bus for Chatham Bars Inn, Cape Cod. Activities there besides lots of reminiscing, included golf, tennis,



Concluding one of the largest 50th reunions in MIT history, the Class of 1941 raised gifts totalling \$5.3 million. Joseph Gavin made the presentation to MIT last June 7.

dancing, beach-walking, shopping, and of course, the obligatory wining and dining.

Wednesday produced a rainy Northeaster and increased the quota of reminiscing. At a class meeting, before the scheduled clambake, **Sepp Dietzgen** was elected class president in place of the resigned **Johnny Sexton**. Both got a standing ovation for past service—Sepp as secretary and John as president. John also headed our reunion committee on which Sepp served.

The clambake at the adjoining Beach Club was another great occasion to socialize. Immediately afterward the class was treated to a surprise chamber music concert by a trio led by **Dave Josefowitz**. Music, a major interest during his career, has been his main activity since he created and became director of the London (England) Soloists Chamber Orchestra in 1981.

Thursday found us outside Kresge Auditorium at MIT for a class photo. **Bob (Wilson) Blake** has definitely lost a step since the old days. He couldn't have his picture on both ends of the group by sprinting around us while the panoramic camera was turning! . . . **Bob (Wallace) Blake** was also there, adding to the confusion since the Alumni/ae Association has been considerate in providing us a coordinator named, you guessed it, Bob Blake!

At the following reception in the President's house, it was a great pleasure to meet MIT's new presidential couple, Dr. and Mrs. Charles M. Vest.

Bob Blake (No. 3) kept us moving for a quick bus trip to Symphony Hall for a Pre-Pops class dinner. The few glitches in service could not dampen the old '41 spirit and the festivities continued. Tech Night at the Pops, itself, was much as remembered, with a program of old favorites and a few selections by artists not understood by many present. We were all intrigued by the process of recording the program for television. This included an introduction of our red-jacketed class by John Williams and the singing of *Sons of MIT* by the audience, including '41ers brought up on *The Stein Song*. You may have seen this PBS program on June 14. After Pops, diehards returned to McCormick Hall for more conversation, coffee, and delicious, do-it-yourself, blueberry, raspberry, or strawberry shortcake.

Friday morning early-risers attended a memorial service in the MIT Chapel. Names of Alumni/ae who passed away during the past year, including members of our class, were available for review. All present expressed their grief as do we.

The morning program of Technology Day in Kresge Auditorium, *Sex, Drugs, Genes, and Obesity*, employed MIT's stars of the programs at the Whitehead Laboratory, including the Human Genome Project. The fascinating presentations

provided an increased understanding of the field, as well as its effect on our personal health.

Technology Day luncheon's high point for the Class of 1941, was Class Gift Chairman, **Joe Gavin's report**. We (66.3 percent of us), contributed a near-record \$5.3 million dollars to the **Alumni/ae Fund**, including \$332,000 for the class project, *The Fund for the Impact of Science and Technology on Public Policy*. Future bequest gifts totaled \$2,096,000. Not bad for a recession and Gulf-War year! Our thanks to Joe and his committee.

The final Class of '41 event Friday evening, a dinner at the Skyline Room of the Boston Museum of Science was preceded by an Imax film which gave one the unsettling feeling of sitting on an open balcony of the Space Shuttle in space. We all survived for a fine dinner to find that the scheduled speaker, MIT 1941 Professor Nan Friedlander, was ill. Not to fear! **Sepp Dietzgen** (Victor Borge, sans piano) demonstrated his missed calling by mc'ing a much appreciated, impromptu program of classmate introductions and performances.

Saturday scheduled the "Techsas" Barbecue at the Athletic Center and "Boston, Made in Cambridge by MIT," a bus tour for all reunion attendees, showing MIT's influence on the Boston skyline.

Some '41ers had also played hooky from seminars Technology Day afternoon. At the "new" boat house, across Memorial Drive from McCormick Hall, another 50th Reunion record was achieved under the leadership of **Charlie Butt**, coach for 40 years of championship high school crews in the Washington, D.C., area. Class of 1941 crews launched two boats on the Charles, as shown in the MIT publication, *Tech Talk photos*.

With **Sepp Dietzgen** busy as president, my Macintosh SE volunteered for secretarial duties. We were sorry to hear **Bill Kussmaul's** "advancing disability, diagnosed as multiple sclerosis" forced his move to "easier living in North Central Florida," and prevented attendance at the 50th. Please keep your new secretary busy with news.—**Charles H. King, Jr.**, secretary, 7509 Seabago Rd., Bethesda, MD 20817, (301) 229-4459

42 50th Reunion

Roger Olsen writes that the World War II meteorology class which graduated on November 30, 1942, is holding a reunion in Boulder, Colo., on September 20-23, 1992. Addresses have been found for all but **John Francis Downing**, **Harvie Bruce Klaus**, and **Edward Ayres Boyd**. If anyone knows of these classmates, please send addresses to Roger at: 1740 Sunset Blvd., Boulder, CO 80304.

John Barry is working on the development of a multi-purpose recreational area (including golf!) at South Shore Country Club in Hingham, Mass. If you want any information on this, get in touch with him at: 454 Main St., Hingham, MA 02043.

You'll get a letter from **George Schwartz** soon asking for voluntary class dues of \$25 for the 50th Reunion Fund. You can't stay at home so cheap, so get the money in to George promptly. With your help, we'll have the greatest 50th Reunion ever!

A note from **Morrie Steinberg** with a copy of an impressive obit for **Marsh McGuire** who died in Hartford, Conn., in January. Our condolences to the family.—**Ken Rosett**, secretary, 191 Albenmarle Rd., White Plains, NY 10605

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We have news of two deaths. From **Jim Spitz** and the Alumni/ae Association comes word that **James Hall, Jr.** (Course II), departed this life October 22, 1990, in Littleton, Colo. Our sympathies go to his widow Agnes.

Capt. **Guy L. Ottinger**, who received a graduate degree in electrical engineering with our class, passed away April 28, in Palo Alto, Calif. Born in

Jamestown, N.D., Guy was a career U.S. Coast Guard officer for 26 years, and later a senior staff engineer at Lockheed. An internationally recognized expert in LORAN and electromagnetic compatibility, he was a member of numerous professional and service organizations. He was also a ham radio operator and an avid golfer. After Navy-Coast Guard ceremonies he was buried at sea. Guy is survived by his widow Lois, three sons, and two grandchildren. We extend our condolences to his family.

On a happier note, **Dick Feingold** sends this bit of folk wisdom from Palm Springs: "As the condemned man said to the hangman, as he stepped onto the gallows, 'No noose is good noose.'"

Betty and Bud Cruckshank have a new condo from which to roam in their RV. Address: 5965 Bloomfield Cir., Apt. 308B, Naples, FL 33962. They are looking forward to the Big Five-OH.

Leo Duval (Course VIB) retired last December from the Navy Public Works Center in San Diego, and now lives in Fallbrook, Calif., near his children and grandchildren. He and Gloria stay active with golf, walking, computer classes, traveling, gardening, and general enjoyment of life.

California State University/Northridge has **John J. Guarrera** as director of its Center for Research and Service, School of Engineering and Computer Science. CSUN has an enrollment of 32,000 students. John is a fellow and past president of IEEE, past president of the National Computer Graphics Association, and a fellow of IAE. He also serves on boards and committees of several professional societies and health organizations.

Our past president of the Alumni/ae Association, **Chris Matthew**, really got around during his term of office. He was sighted by **Jim Hoey** on Cape Cod in December, addressing the MIT Club there on the subject of engineering and technology awareness among local school students. In April, he visited Florida and Los Alamos, then touched base with **Harry Ottinger** and other New Mexico alumni in Albuquerque, followed by stops in Salt Lake City and Pittsburgh. In May, he attended a meeting of our 50th Reunion Class Gift Committee in Cambridge, on the way to a tour of several countries in Europe to promote organization and support among alumni/ae in that part of the world. June found him and Marjorie back in Cambridge, joining in Alumni/ae Week activities with **Ros** and **Jim McDonough**, **Barbara** and **Malcolm Walker**, **George Freedman**, and your secretary. He turned over his presidential duties to his successor, but he will remain active on the Association Board of Directors and as a Member of the Corporation.

Speaking of **Malcolm Walker**, I saw him at the Pops concert and I am convinced that he lives backwards in time. He doesn't age, he youths.

I appreciate all the news, but remember, I need a fix every month.—**Bob Rorschach**, secretary, 2544 S. Norfolk, Tulsa, OK 74114

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By the time you read these notes, the mini-reunion in Charleston, S.C., should be well underway. We hope all who are in attendance are enjoying themselves and those of you who couldn't attend will make the 50th. The dates for the 50th are June 1-7, 1994. Put those dates aside now. Remember, you can only attend your 50th once, there are no second opportunities.

We regret the passing of **Alfred J. Ehrat** on March 13, 1991. We extend our sympathy to his two sons.

Bob Barnaby, **Hank Bowes**, **Lou Demarkles**, **Peter Matthews**, **Bob Smith** and **Melissa Teixeira** attended Technology Day, Friday, June 7. The program was outstanding.

The inauguration of **Charles M. Vest** as the 15th President of MIT on May 10, 1991 in the Great Court was a very impressive event for those of us who were there. It was almost 75 years to the

day, when a great pageant was held in the same Court to celebrate MIT's move to Cambridge from Boston on June 13, 1916.—co-secretaries: **Andrew Corry**, P.O. Box 310, W. Hyannisport, MA 02672; **Louis Demarkles**, 77 Circuit Ave., Hyannis, MA 02601

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Classmates **Emily "Paddy" Wade**, **Jim Levitan**, and **Chris Boland** appeared quite prim and proper as they paraded in official capacity at President Vest's Inauguration on Friday, May 10. On the other hand, **Nancy** and **Charlie Hart**, **Jean Boland**, **Jake Freiburger**, **Pete Hickey**, **Fran** and myself remained casual and relaxed during this festive occasion. So relaxed that I agreed, subject to **Chris'** arm-twisting, to be 50th reunion chairman.

I might parenthetically add that we are considering a 47th or 48th reunion in Bermuda in an effort to properly prepare for our 50th. Any interest?

Some 24 hours after Vest's inauguration, **Jake Freiburger** wound up in Mass. General Hospital for a week of care and frustration. Frustration obviously to **Jake** but also his son **Erich**, a philosophy professor at Boston College, who had expected Dad to help prepare **Erich's** new old sailboat for sea.

Pete Hickey, **Jim Brayton**, and I spent some time cheering **Jake** up during his hospital stay, and when I left **Jake** at his son's Brookline apartment on May 17, **Erich** was ready to load the old man into his car and take him to Scituate, as the boat had awaited **Jake's** arrival. Isn't that what Dads are for?

Nancy Hart reports that the **Harts**, **Chuck Pattersons**, **Chris Bolands**, **Jim Pickels**, **Tom McNamaras**, **Bob Maglathlins**, **Frank Gallaghers**, as well as **Bill Meade**, represented the class at this year's Pops concert. **Nancy** indicated that the TV cameras not only proved a great distraction but, more importantly, caused the group to be displaced from their usual good seats! Oh well, here's to progress.

Frank Gallagher underwent a triple bypass operation last fall, but the operation kept him away from his beloved wind surfing for only a matter of weeks. . . . By the time you receive these notes, **Jim Pickel** may be in Russia helping the Gillette Co. build a new razor blade facility. You may recall that **Jim** spent his first career as an engineer at Gillette, retiring about 1983. One of his hobbies through the years has been Russia—its culture, people, and language—and now it is obvious why he may be in Russia.

The April 15 issue of *Forbes* had an article on **C. Brewer & Co.**, the world's largest macadamia nut and guava company. Yes, one of the principal investors in the company is our own **Sheridan Ing**, chairman of Aloha Airlines. . . . **Jason Z. Levine** of Woonsocket, R.I., received a J.C. Penney Golden Rule Award last April for his many years of volunteer leadership at the Woonsocket Family and Child Service Resources Center.

Ed Stolz of Cherry Hills Village, Colo., advises that his Subchapter S advisory corporation has been relocated to his home, which certainly tells us tax dodgers a thing or two. Lots of golf, local travel, winters in Phoenix with side golf trips to California, etc. **Ed** continues to work as a volunteer for SCORE-SBA and the Better Business Bureau as well as American Arbitration Association as an arbitrator in construction and engineering.

Unfortunately we are at an age when death descends upon our friends and associates. In late May, **Chris Boland** called to advise that **Bob Schumacher's** wife, **Peg**, informed him that her husband died of cancer of the pancreas on May 21, cancer having been diagnosed in mid-February. Many of you will recall that **Bob** had been a Chicago-based patent attorney.

On Saturday June 15, I received a call from **Jeanne** in Williamsburg, Va., advising that her

husband, **Bill Martin**, had died of lung cancer on May 15. Bill had been weakened during the winter months by an inflammation of nerve ends that caused weakened muscles. The medicine used to correct this defect weakens the immune system, which caused a latent bladder cancer cell to spring loose, and ten days later Bill was gone. Bill spent his formal business career with Johnson Controls—Boston, Chicago, and New York. As a Darien, Conn. resident, Bill took early retirement and enjoyed a few years of consulting before retiring to Williamsburg to golf and see the grandchildren.

We mourn the loss of these two very special classmates.

Yes, I still need your news!—**Clinton H. Springer**, secretary, P.O. Box 288, New Castle, NH 03854

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A lot of "bytes" have come through since the July issue including the gap I left in the Aug./Sept. column due to our "back-east odyssey" in May/June, stopping along the way in Cambridge to join the Technology Day happenings and seeing an assortment of old friends including our current president, **John Gunnarson**, with whom we stayed a couple of nights in his pleasant Concord country home. John is still vice-president and treasurer of Metritape, a Marine Tank Gauging company (at it's best), in Littleton, where he has worked the past 25 years. We ran into old swim-team buddy, **Ted Henning**, and good old **John Taylor**, still in Baltimore, before packing into the Kresge auditorium for some high-tech presentations, sharing the Friday morning session. After tip-toeing into the *Technology Review* "Sherry Toast" for the class secretaries—a very nice experience—we tumbled into the luncheon session, where I shook hands with **Bob Lemon**

Wentsch. We made our way back to Concord while the class "movers" moved over to the Sonesta Hotel for dinner and revving up for the "big show" at Kiawah Inn on October 11–13 for our 45th Reunion. The committee members, which I regret having missed, included: **Bob Spoerl**, responsible for general arrangements; **Jim Craig**, arranging facilities for meals/refreshments for Friday/Saturday parties; **Mason Lappin**, Travel and Transportation; **Glen Dorfingler**, Publicity and Communications; **Bob Hoffman**, Gift and Saturday Entertainment; and **John Gunnarson**, Class Business/Election of Officers.

About a month before this I was invited to a newsletter editor workshop at Pendel Hill, near Swarthmore, Pa., where I spent a weekend tuning up techniques for my monthly Friends Meeting chore. What made it wonderful was the opportunity to stay with old roomy, **Al Little**, whose blissful house and grounds and wife Marian, were within reasonable hiking distance from the Hill. Al is retired but still "on-call" for special GE assignments. We shared a couple of pleasant evenings.

We got a short thank-you note from one of our Course II alumni, **Nestor Perez Leboff** from the deep south—Caracas, Venezuela, to be exact. He indicates interest in attending our 45th. I hope he makes it! . . . Another thank you came from a man in the Class of '49, saying how glad he was that reading this column allowed him to find, after 40-some years, his Brooklyn Tech High School classmate, **Mario Vinci**. They have been corresponding since then. Mario, as we mentioned a while ago, is a registered financial representative in Irvine, Calif. . . . A somber note is about a classmate, **Arthur Linz**, a physicist and electrical engineer at MIT from 1958 until he retired in 1986. He spent his last years in Vero Beach, Fla., where he "made the transition" after 18 months of cancer. He was 65.

ENJOY THE 45TH. Sorry I can't make it.—**Jim**

Ray, secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

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45th Reunion

This month we have a package of brief (sometimes cryptic!) notes about a number of classmates, compliments of notes from phone calls by Alumni Fund solicitors.

In alphabetical order: **Hilmi Arslan** was planning to spend the month of May in the ocean off Long Island and the Bahamas to photograph bull sharks while they're feeding. (Not my cup of tea!)

. . . **Dudley Church** retired from Crown Zellerbach before it was bought by Sir James Goldsmith, and now spends half his time in Vancouver, Wash., and half in Bend, Oreg.—hiking, fishing, birdwatching, etc. . . . **John W. Connors** retired from Pratt & Whitney in 1983 as VP-Advanced Engines and now is enjoying life with his wife Evelyn and their 10 grandchildren.

. . . **Morgan H. Cooper** will be leaving Barber-Colman where he's been manager-Strategic Planning for the past 12 years) to become V-U.S. Operations for Alacritous, Inc., a Canadian software development company.

Eugene M. Gettel left Merrill Lynch about 18 months ago and is consulting in the areas of estate planning and retirement planning. He says he's doing what he did before but without the big-company hassle—and he's having fun at it!

. . . **Walter Kern** is still chief mechanical engineer at Teradyne. His daughter Jill is with Digital Equipment Corp., and his son was with Desert Storm when Walter was contacted. (We hope his son is home now.) Walter is playing tennis about three times a week, and lives in Cohasset, Mass.

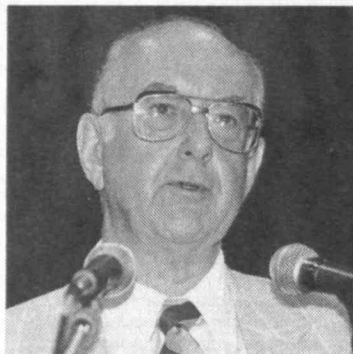
. . . **Jack B. Lehmann** is VP of Ottenheimer, which provides uniforms for hospitals. Jack has four children—three boys and a girl. His sons are, respectively, an attorney, a financial analyst, and

If it weren't for ProNet, I wouldn't have this job. I applied for a position and didn't hear anything. At the same time my resume came up on a ProNet search for that job. The search resulted in an interview for me... and the job I really wanted. ProNet made the difference.
Mark Peters '87
West Palm Beach, FL

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Technology Day chair George Clifford, '48, and his committee put together a series of events that drew some 2,000 alumni/ae and guests.

a professor of economics at Columbia. His son-in-law is an attorney. Jack had two valves replaced two years ago.

William E. Little retired from Little & Co. (construction and real-estate development), and his two sons and a daughter are now running it while he plays golf. . . . **Paul Moschella** is chair of the Management Department, Barney School of Business, at the University of Hartford, West Hartford, Conn. . . . **Aaron Newman** and his wife Florence bought a condo in Florida in February 1990 and tried it out over the winter of 1990-91. They like it, so will continue wintering in Florida. (Their permanent residence is in Orangeburg, N.Y.) They are enjoying their first (and only) grandson and also recently celebrated their 40th wedding anniversary with a five-week trip to New Zealand and Australia. . . . **Harold Raiklen** is a graduate student in anthropology at the University of California, Long Beach, and was just inducted into the honorary society Phi Kappa Phi. (Hal, write us and tell us about your decision to go back to school again.)

Unfortunately, we have several death announcements to pass along this month. . . . **Dogan (Don) H. Erokan** died July 13, 1988. He was born in Jerusalem when it was still part of the Ottoman Empire. He graduated from the Turkish Naval Academy in Istanbul in 1937 and then served in the Turkish navy until retiring with the rank of commandant in 1954. He got his degree in naval architecture from MIT during that time. Then he worked for Lockheed Missiles and Space until retiring in 1982. There he was involved in a number of top-secret projects, including the RIFT and Polaris programs and the Glomar Explorer. He is survived by his wife Anita, two sons, Dennis and John, and one daughter, Susan.

Wilton M. Fraser died suddenly in February, 1991, from a cerebral hemorrhage. . . . **Albert Openshaw** died May 21, 1991, in Amsterdam, N.Y., after a long illness. He joined Mohasco Industries upon his graduation from MIT in 1947 and spent his entire career there, retiring in 1982 as VP of Carpet Operations. He was the former director of the Amsterdam Chamber of Commerce. He is survived by his wife Muriel; a son, William of Ithaca, N.Y.; two daughters, Jean Jennison of York, Maine, and Gail Ramsey of New Castle, Del.; and two grandchildren.

Robert K. Schumacher died May 18, 1991, at his home in Winnetka, Ill. Following his MIT degree, he attended Harvard Law School and graduated in 1950. He spent his career in patent law, first with Mobil Oil Co., then with Well Surveys, Inc., a subsidiary of Mobil, which was later acquired by Dresser Industries. (Well Surveys was the originator of nuclear well logging, the first commercial use of nuclear processes.) When Robert died, he was a senior partner with the pa-

tent law firm of Fitch, Ever, Tabin & Flannery in Chicago.

Donald H. Strider died February 22, 1991, at his home in North Syracuse, N.Y., after a long illness. He was an engineer with General Electric in Syracuse for many years. He is survived by his wife Vivian, two daughters, Susan and Sandra, and a son, James—all living in the Syracuse area.—**Robert E. McBride**, secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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By the time you read this, our September reunion at Martha's Vineyard will be over. As of June 15, we had 48 reservations.

Part of our 40th Reunion Class Gift was used by MIT to create the Class of 1948 Professorship. Associate Professor Mehran Kardar, PhD '83, of physics is the first recipient, and he will hold the chair for a two-year term.

Mehran, a condensed matter theorist who works primarily on problems in statistical physics, has made important contributions in a wide variety of areas, including dynamics of growing interfaces, polymers in random media, morphological transitions in membranes, and the phases and phase transitions in thin films and layers. By developing a continuum field theory for random manifolds, such as polymers and membranes, he established the roles of elasticity, rigidity, and interactions in determining macroscopic phases of such objects. He received his bachelor's and master's from Cambridge University, England. He was appointed to the MIT faculty as assistant professor in 1986, and he became an associate professor in 1990.

Mehran received the 1991 Harold E. Edgerton Award, which is given to young faculty members for outstanding achievements in research, scholarship, and teaching. The graduate statistical mechanics courses that Mehran developed and now teaches are truly outstanding in the view of many students and faculty alike. He attracts an audience from the departments of physics, chemistry, and chemical, electrical, and nuclear engineering, not only from MIT but also Harvard, Boston University, and Brown. He is also involved with the Institute's community life. For the past three years, he has served as a Fellow at the Ashdown House. He has arranged to take groups of students to symphonies, ballets, and basketball games. Students in his courses join him for hikes, weekly dinners, and basketball games. He received a Presidential Young Investigator Award. He has been a prolific writer, and the papers are mostly coauthored with students who have studied with him. He has been invited to Belgium, Brazil, Columbia, France, Hungary, Italy, and the Netherlands to present lectures.

On Technology Day last June, Mehran accepted my invitation to attend the luncheon and join Betty and Bill Maley, Harry Jones, Bob Ormiston, Milton Slade, Mary and Bob Cowan, '49, and yours truly. **George Clifford** was chairman of the Technology Day program. He and his committee provided an excellent program with faculty from the Biology Department. Before Tech Nite at the Pops, we had a mini-reunion with the Classes of '47 and '49 in the Phi Beta Epsilon fraternity's living room. Tel and **Bob Sandman**, **Peter Saint Germain**, **Nancy** and **Don Noble**, **Judy** and **Graham Sterling**, **Mike Oglo**, and yours truly were there.

Jack Page and his wife, Imogene, were participants in the Cumbres and Toltec Scenic Railroad's snowplow trip. He writes, "It was great fun to ride in the open gondola car behind the 70-year-old, steam-driven rotary snowplow as it blasted through ten-foot drifts of snow. This was the first time in eight years that plowing was required to open the line for its scheduled scenic runs. The volunteers who manned the plow had never run it, so it was a learning experience for them. First they plowed up the 4 percent grade, using two steam locomotives to push the plow. Then they sent one locomotive down to get the

train of passengers to follow the plow as it went down the other side of the mountain. The only problem was that the train got stuck in climbing back, and the little engine that thought it could, couldn't. The other engine that had stayed at the top had to rescue the passengers."

CBS had spectacular footage of the event on Dan Rather's 5:30 news, but unfortunately the interview with Imogene and Jack ended up on the cutting room floor. Jack writes, "Deservedly so, as our brains were on vacation when we were questioned as to how we liked the experience."

Ben Ball wrote a column for the *New York Times* Sunday Business Section. He reviewed government and industry policies since 1973: uneconomical alternative energy sources like shale oil were "demonstrated," renewables like photovoltaics were funded, irrational conservation was subsidized, and the use of indigenous gas was illogically depressed. Energy use was discouraged with rhetoric while it was encouraged by price controls. Since the U.S. government neither produces, refines, nor distributes significant energy, it is not a player in the marketplace and has limited influence. Ben said, "Americans are not inherently wasteful. We use more energy because it is cheap; the price of gasoline at the pump is one-half to one-quarter of that of other industrialized nations because of lower taxes, not lower costs. It makes no sense to spend a dollar conserving what costs only a dime."

Market imperfections aside, alternatives will make their way to market without government interference if they are economically sound. If they are not sound, government interference is unlikely to make them so. Likewise, conservation will occur when it is economically attractive.

Ben writes, "If we are serious about conserving oil, we should join the rest of the industrialized world and raise petroleum taxes, not by pennies but by dollars per gallon. Then economically rational decisions would make Americans use less energy and help bring viable alternative energy sources to market. Conservation would be an economic choice; imports would be reduced and pollution would lessen." Ben concludes, "A key lesson of the last 18 years is this: the best American energy policy is close to none at all, except that oil should be taxed severely. Then let the market do its job without government interference."

Ed Kowower has written a book, *Molecular Mechanisms for Sensory Signals—Recognition and Transformation*. Ed holds the Chair of Biophysical Organic Chemistry at Tel Aviv University and is adjunct professor at the State University of New York, Stony Brook. He writes about the questions of how we learn and how memory is made, and he introduces a novel approach to connecting molecular properties with the biological properties that enable us to write and read, to create culture and ethics, and to think. He examines what happens within a single cell in reaction to external stimuli, and shows the parallels between single cell and multicellular responses. To address the problem of learning, Ed explains the molecular mechanisms of responses to input from taste, olfactory, and visual receptors. He then shows how these and other processes serve as a basis for memory. Among the signals for the molecular process of learning that Ed describes are pheromones (the molecular signals for mediating behavior) and light (which activates the G-protein receptor, rhodopsin). His discussion of the structure and function of these complex molecules has direct implications for such areas as molecular neurobiology, bioorganic chemistry, and drug design, in elucidating approaches to the structure of drug targets.

Roland Nagy retired from Foster Wheeler in January 1988. He has worked on the editorial staff preparing a comprehensive history of the company, which celebrates its 100th anniversary this year. . . . **Howard Brownson** retired after working 42 years in worker's compensation and safety in California. **Gordon Johnson** and his wife

visited Howard, and they had a nice chat. They were in the same V-12 class.

Francis X. Crowley died last April after a long illness. He was the president and treasurer of Natgun Corp., a specialty contractor in the construction of prestressed concrete tanks. He began his career with Natgun in 1948 as a construction engineer and was appointed vice-president and director in 1961. He purchased the small, regional company in 1973 and expanded it into a national specialty construction firm that has built water storage tanks throughout the U.S. and overseas. During that time, he developed and held patents on numerous tank design and construction improvements including the precast, prestressed concrete diaphragm tank that has become a standard in the industry.

He received several awards: among them, the Best Paper from the American Water Works Association, and in 1990 their New England chapter presented him a special award for outstanding support and dedication to the water works industry. He was a Sustaining Fellow and Life Member of the MIT Alumni Fund.

Francis was a registered professional engineer and was the author of numerous professional papers and articles on prestressed concrete tank design and construction. The N.E. Water Works Association endowed the Francis X. Crowley Scholarship for engineering students and named its new training center after Francis. He and his wife, Geraldine, had three children and two grandchildren. They lived in Wellesley.

Joseph Murphy died in Wellesley. He was a real estate developer. He and his wife, Eileen, had three daughters. On behalf of our classmates I extend our sympathy to the wives of these classmates and to their families.

Bruce Moseley's wife died recently. Before her death, Betty fought a heroic three-year battle with cancer. Bruce and Betty had two children and one grandchild. Bruce retired from Proctor and Gamble a while ago, and he is living in Richardson, Tex. On behalf of our classmates, I extend our sympathy to Bruce and his family.—**Marty Billett**, secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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From a news release by the Optical Society of America (OSA), dated March 21, 1991, we learn that **James P. Gordon** of AT&T Bell Laboratories is the 1991 recipient of the Max Born Award for achievement in physical optics. Jim is recognized for his many original contributions to physical optics, including lasers, the theory of quantum noise in laser and in optical communications, radiation pressure, ultrafast phenomena, and solitons in optical fibers, and for his fruitful and selfless assistance to others.

Jim received OSA's Charles Hard Townes Award in 1981. He is a fellow of the OSA and of the American Physical Society, a senior member of IEEE, and a member of both the National Academy of Engineering and the National Academy of Science.

From Oslo, Norway, **Ove Collett** writes that he is retired. I remember Ove well just as I do his fellow Vikings **Gunnar Christensen** and **Harold Bjerke** from our days on the student staff at Walker. Anyway, Ove says he is a member of the boards of two trust funds. One provides partial financing for Norwegian students in other countries. The other finances medical research in Norway and various humanitarian institutions. Finally, he is an active member and member of the board of the Norwegian Section of Amnesty International which has 40,000 members. In a concluding note, Ove says he has been married to his wife, Kirsti, for 44 years.

Walter S. Cremens has retired from Lockheed-Georgia and begun a new career as a materials and manufacturing engineer with the U.S. Army Materiel Command. Says Walter: "Nobody laughed when I joined the Army at age 18. So,

why do they think it's funny now?" . . . On April 1, 1991, **Bob Bigelow** retired as a vice-president from New England Electric System where he served for 40 years. Now that he has time, he looks forward to sailing, golf, and being with his family at Woods Hole, Mass.

We are indebted to **Frank Hulswit** for the following report concerning the way in which the Class of 1949 Scholarship Fund is being used: "A letter from Beth Ann Scheid (of the Student Financial Aid Office) to **Tom Toohy** (class president) reports that the principal balance of the Fund reached \$635,348.88 on April 30th, and that the interest earned now supports five students with an average award of \$6,900. (Secretary's note: In her letter, Ms. Scheid emphasizes that these students, like many others at Tech, share a high level of financial need and are all dependent upon scholarship assistance to continue their studies.)

"From the class of 1992, our Fund recipients for 1990-91 are: David S. Cherry, from Hadley, N.Y., majoring in earth, atmospheric, and planetary sciences; and Jonathon C. Clay, from Cooperstown, N.Y., and Yvette Morgan, from Portsmouth, Va., both majoring in brain and cognitive sciences.

"From the Class of 1993, our recipients are: Anna C. Jen, from Taipei, Taiwan, majoring in chemical engineering; and Bilal A. Khan, from Birmingham, England, who is studying electrical engineering and computer science.

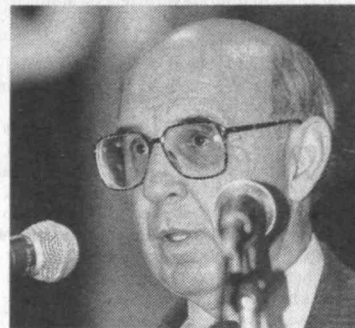
"Tom also received a letter from Anna Jen, now in Baton Rouge, La., as a summer Intern with Exxon: 'I was very pleased and honored when I heard from Ms. Scheid in the Financial Aid Office about my selection as one of the recipients of the Class of 1949 Scholarship Fund. I would like to thank the Class of 1949 for establishing this fund to assist students like me with the overwhelming expenses of an education at the good old "Tute." The award is much appreciated! . . . As a chemical engineering major, I am still exploring the various directions my future degree can lead. I am counting on the UROP (Undergraduate Research Opportunities) experiences as well as summer internships to help me decide what to concentrate on. The field I choose will in turn determine whether or not to continue my education in graduate school, though I do hope eventually to get an MS and perhaps even a PhD. . . . Thank you and your classmates again for the wonderful gift. I will do my best to make everyone proud."

Word has been received from Mrs. **Francis Valentine McCorry** that her husband passed away on June 17, 1989. Regrettably, there are no further details. I am sure I reflect the feelings of the class in extending condolences to Mrs. McCorry and the family.—**Fletcher Eaton**, secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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John E. Anderson of Katonah, N.Y., and a senior corporate fellow of Union Carbide has been elected to the National Academy of Engineering. **John Ertel** has announced his retirement. Best wishes, John. . . . The February 1991 issue of *The Scientist* had a fine write-up on Benthos, Inc., and its president and our classmate **Sam Raymond**. Sam's early association with Woods Hole Oceanographic Institute and his entrepreneurship led to the formation of Benthos more than 25 years ago. Benthos produces many products for the marine environment.

Dr. John H. Litchfield has been elected to the presidency of the Institute of Food Technologists. He began his term of office July 1, 1991. . . . **Lou Stark** reports that he, his wife, and several members of his family had a wonderful vacation recently sailing a chartered sailboat in the South Pacific area of Tahiti. . . . **Sidney Topal**, who retired as chair of Scientific-Atlanta, has been elected to director of Monitor Television, Inc., of



On June 7, William Maini (above) and Marvin Grossman, gift co-chairmen for Class of 1951, gave MIT \$4,566,000 from 63 percent of their class members.

Boston.

As a follow-up to my recent request for correspondence from the class, **Bill Enders**, with a reported stimuli, his wife, wrote to tell us his experiences for the last few years. Bill resigned from GTE in 1987 and moved to Guilford, N.Y., on the shores of Lake Winnepesaukee. He had been VP of marketing for GTE in worldwide consumer electronic products. He states that his decision to retire from the constant travel, entertainment, etc., of the corporate world was the best decision he ever made. He then became an independent contractor realtor, associating with Century 21. He also made the most of his leisure time by becoming a certified scuba diver. He writes about the experiences of the older, more cautious diver. He has also been quite active in numerous community activities in his area. His last vacation consisted of a trip around the world, including diving on the Great Barrier Reef and a trip to the Taj Mahal in Agra. Bill has recently been appointed to the National Advisory Board of the Descriptive Video Service (DVS), which is a free service to make television accessible to the blind and the visually impaired. Bill is working with WGBH, the developing agency, on strategies for the growth of this new service. Bill and Jean are celebrating their 40th wedding anniversary this year. I would like to hear more from others, and thank Bill and Jean for responding to my request.

Condolences to the family of **Robert H. Burke** of Oswego, N.Y., who is recently deceased.—**John T. McKenna**, secretary, 182 Midpine Rd., Box 376, Cummaquid, MA 02637

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There are some rare instances when you prepare for a special occasion for a long period before it occurs. You develop strong expectations and just pray the event is able to meet some fraction of what you hoped it would be. It happens. . . and magically it turns out to exceed your highest dreams. That is just what those of us who were fortunate to attend our 40th Reunion realized. It couldn't have been better. There were 286 of us attending. Just the opportunity to be together with that many special people would have been enough.

It started on a high note with our opportunity to meet Dr. Charles Vest, MIT's newly inaugurated president at a reception at his home. The events following seemed to get successively better. There was an elegant dinner at the rooftop room of the Science Museum that presents a magnificent view of the Charles River basin.

Friday started with a guided two-hour bus tour of Boston. It seemed as though virtually every

major building that constitutes Boston's skyline was either designed or constructed by some graduate of MIT. A highlight for me occurred when we passed the beautiful glass and steel Hancock building. I knew that it was designed by I.M. Pei, but I had not realized how close it came to being denied an occupancy permit. **George Butzow**, who was on our bus, explained how a dynamic damping system designed by his firm was able to control the wind-initiated oscillations that threatened to make the building unusable. It was saved by George's first-of-its-kind system consisting of two 300-ton lead weights at the top of the structure that are tuned using a pneumatic spring mechanism to control the vibration. The ability to install a system like that in a building already up was an even more interesting story.

That night we were treated to John Williams conducting the Tech Night at the Pops. The performance was video taped and will appear on PBS television July 14. The Technology Day presentation featured the achievements of MIT's Biology department. This organization has grown and now enjoys the stature of being the foremost organization of its kind in the world.

Each of us shared in the pride of our own class's accomplishment when **Bill Maini** and **Marv Grossman** presented our class gifts to Dr. Vest at the Technology Day luncheon. Our class established the Class of 1951 Fund for Excellence in Education and supported it with a contribution of \$702,000. Our total 40th Reunion gift was \$4.6 million. Sixty-four percent of our class participated in this gift.

Following the Technology Day functions, we traveled to the Chatham Bars Inn on Cape Cod. The first night there we had a clam bake, but the highlight was the Saturday night banquet. Along with a sumptuous meal, I had the fun and honor of presenting the results of our 40th Reunion class survey. This was followed by a hilarious talk by **Fred Ezekiel** on how he, as a newly arrived student from Baghdad, was able to survive his freshman year in the barracks at MIT. At the banquet, **Bill Maini** announced that the person most responsible for our wonderful 40th Reunion, **Harold Glenzel**, would be our new class president.

The following day, it was almost hard to believe that this wonderful event was about to end. For all of us there, it will continue as a very special time and memory. Members of Harold Glenzel's reunion committee all deserve our gratitude for their efforts in making this all happen. The members include **Fred Bumpus**, **Bill Cavanaugh**, **Fred Ezekiel**, **Marty Greenfield**, **Fred Lehmann**, **Howie Levinston**, **Bill Maini**, **Marty Murphy**, **Peter Philiou**, **Dick Reedy**, **Jay Rosenfield**, **Mike Lecar**, and all of their wonderful wives.—**Martin N. Greenfield**, secretary, 25 Darrell Dr., Randolph, MA 02368

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I was glancing at a popular science magazine and saw a report that someone had computed that a ferromagnetic monolayer of atoms such as iron or cobalt had anomalously high magnetism, more than several layers of atoms did, and that this discovery had been confirmed by experiment. On closer reading, the "someone" turned out to be **Art Freeman** of Northwestern University. The discovery may be of importance in the development of magnetic disk memories, but it is an impressive piece of work in any case.

Art is not the only classmate pushing ahead in technology. **Robert Shaver** writes that he formed a new business last year in Fredericksburg, Va., called Carbonspheres Inc., to manufacture hollow carbon microspheres and low-weight radar absorbing material. With defense business drying up, he may have to sell it to people who want to defeat radar speed detectors.

James Stolley, of Erie, Pa., writes that he is back skiing, playing squash, and sailing after having had an aortic valve replacement last year.

Since he retired two years ago, he and his wife Maggie have sailed to Yugoslavia and canoed in Alaska. . . . **John Maxwell** has gone from semi-retirement to managing a partnership that produces specialized collectors' shows in California that attract collectors from all over the country.

I was sorry to learn that **Robert J. Pascoe** of South Glastonbury, Conn., died April 20, 1989. He is survived by his wife Amalia.—**Richard F. Lacey**, secretary, 2340 Cowper St., Palo Alto, CA 94301

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I have a number of items this month, so I'll get right to it. **Roy Sjogren** reports that he retired from Aerojet in August 1990 after suffering a stroke in December 1989. He underwent six-way bypass surgery in September 1990 and is nearly completely recovered with only moderate dependence on a cane. He is very grateful to the caregivers and the advanced state-of-the-art of health care and to those near and dear to him, especially his wife, Jan. I suspect he would like to hear from his old school buddies. His address is: Roy G. Sjogren, 2011 Carson Hill Pl., Gold River, CA 95670.

Sidney Gravitz retired from Boeing last year, after over 29 years of working on AWACS, 747, Space Shuttle, Saturn/Apollo, Advanced Surface Transportation Preliminary Design, and others. He now divides his time between consulting, teaching, and portfolio management. . . . **Albert Lee** is continuing to provide technical support on the commercial production of Amorphous Metal Core Transformers. He indicates that his oldest daughter works at NCR in Columbia, S.C. His second daughter got married in June 1990 before graduating in electrical engineering from N.C. State University in August. His youngest daughter is a junior at Duke University majoring in biomedical engineering.

Dave Klepper made a trip to Jerusalem over Passover and also visited Istanbul, Turkey. He inspected the sound systems and acoustics in two Klepper Marshall King auditoriums, one in Jerusalem and one in Istanbul, and two auditoriums designed by colleagues in Tel Aviv and in Istanbul. . . . **Stan Zisk** says that he is finally settling in to life in Hawaii after only three years of living in our most western state and ten years of delightful visits before making the move. He is now a professor in the Department of Geophysics at the University of Hawaii. He is turning his research attention away from the sky and planetary radar to the sea floor, acoustic imaging, and similar problems.

I also received a nice long letter from **Fred Brecher**. Fred attended the inauguration ceremony of MIT's new president while he was in the Boston area for the graduation of his son from Boston University. He said that the inauguration ceremonies were very impressive and well done. Fred ran into only one of our classmates while there, **Howie Stern**. In addition to his doing quite well, Howie reported that **Jay Berlove** was also doing fine. Fred also reported that his entry into a business of his own, eight months ago, was not intended to hit the start of a recession, but his crystal ball was a little cloudy. His previous client base is carrying him along, but the potential for new business in this market is small.

Fred's final comment related to the upcoming Class of '53 40th Reunion which will be only 18 months off when you read these words. Let me raise the flag once more. Please make your plans early and reserve that time in June 1993 to join us in Cambridge. I've attended all but one reunion since graduation (missed because of an overseas tour). I have greatly enjoyed every one that I did attend. It is delightful to renew old acquaintances and meet some classmates that I didn't have an opportunity to know while at Tech. I recommend the reunion to you all. On behalf of **Marty Wohl**, our class president, and myself, I'd

like to solicit the help of our New England classmates in setting up the gala affair.

Finally, I'd like to announce that **Marty** is looking forward to getting married this weekend, the 30th of June 1991, to the lovely **Kay Hudson** of Washington, D.C. Kay is a cost analyst in the Department of Energy. Someone told Marty that the third time is the charm. We wish him happiness and long life.

Let's make Marty's job as class president easier by getting in gear for the reunion. So long until the next time. Keep the items coming so I don't have to tell you all about the comings and goings of the Gardner Clan, seven kids, with five spouses, and 8.98 grandchildren, (number 9, whose father is David Gardner, MIT Class of '78, is imminent). I'll be waiting for your news.—**Gilbert D. Gardner**, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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Lois has sent an update on **Howard Brody's** life. She reports that he is still sports physics professor at the University of Pennsylvania and is concentrating his research on the physics of the tennis racket. But he also took over as tennis coach when the regular men's coach took a leave of absence. Under Howard's guidance, the team beat everyone in sight, making him the only undefeated men's tennis coach in Pennsylvania history. Congratulations, Howard! Lois and Howard still live in Philadelphia, and have two grandchildren, ages 3 and 4, in Los Angeles.

Ed Markowski has informed us that he retired in 1983 and spends his time traveling and farming seven acres of limes. . . . And **Bob Mason** sends word that he also retired a year ago from Hunterlab, Inc., in Reston, Va., after he had developed the Process Image Color Control System for graphic arts color printing. He turned the system over to the marketing folks and retired. Cool move.

Word has come that **Ezra Ehrenkrantz** is chair of the Architecture and Building Science Group at the New Jersey Institute of Technology in Newark. . . . **Gerald Golden** is manager of materials characterization and processing at the United Technologies Research Center in East Hartford, Conn. Last spring, he was honored by the center for his work on the corporation's environmental policies and programs, especially in the area of hazardous waste minimization. His work helped Pratt & Whitney earn an Air Force contract to evaluate and demonstrate various hazardous waste reduction techniques for gas turbine manufacturing.

We are sorry to have to report the deaths of two members of the class. **Charles Loud** died in August, 1990, in Waterbury, Conn. . . . **George Okun** died last February in New Rochelle, N.Y. George was retired for many years from Grumman Aerospace Corp. . . . Our sincere sympathy goes to the families of Charles and George.—**Edwin G. Eigel, Jr.**, secretary, 33 Pepperbush Lane, Fairfield, CT 06430

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Thomas Marlow II (Course I) has accepted the positions of president and CEO of Fischbach & Moore, Inc., and executive vice-president of the Fischbach Corp. He has returned to New York to take up these positions after a very enjoyable six months of living on the beach in Southern California. Tom reports that his family is fine, now including three grandchildren.

George Rubissow (Course VIII) writes from Paris, France, that he is continuing consulting in Industrial Development and Foreign Trade in Europe. At the same time, he is launching in 1991 his first premium Napa Valley wine on the market—at long last! Just a small quantity of Merlot, to be available in California under the name "Rubissow-Sargent." Next year he is expecting to

offer larger quantities of 1988 and '89 Cabernet Sauvignon. George deplors the fact that MIT and Course VIII did not help him much with the secrets of making consistently good wines, although he acknowledges that the basic mental tools and outlook were, in fact, probably planted somewhere there (perhaps as an apostrophe to Schroedinger's Equations?).

News notes are getting thin! What's happening with the rest of you?—Co-secretaries: **Roy M. Salzman**, 481 Curve St., Carlisle, MA 01741; **James H. Eacker**, 3619 Folly Quarter Rd., Ellicott City, MD 21043

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Please send news for this column to: Co-secretaries: **George H. Brattin**, 39 Bartlet St., Andover, MA 01810, (508) 470-2730; **Irwin Gross**, Sweets McGraw-Hill, 1221 Ave. of the Americas, New York, NY 10020, (212) 512-3181

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Please send news for this column to: **John Christian**, secretary, 23 Fredana Rd., Waban, MA 02168

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Leading off this month's column is some news from folks we haven't heard from for a while. In Seattle, Boeing Defense and Space Group has named **Richard Hardy** as vice-president for its F-22 Advanced Tactical Fighter (ATF) program. Dick will serve as senior manager for activities within the group's Military Airplanes Division in support of Boeing's role as a member of the F-22 ATF Team. Dick has been with Boeing since graduation and involved with the ATF program since 1983. Earlier assignments included short-range attack missile and subsonic cruise armed decoy programs, the C-14 transport and F-111 mission adaptive wing programs, and the Apollo/Saturn program.

Speaking of the aerospace industry, **Jim French** writes that he is now a consultant on spacecraft launch vehicles and propulsion systems. His clients include DOD, NASA, and various industry clients. . . . **Fred Davis** has been deputy under-secretary of state with the Ministry of Agriculture, offices located at Rajdamern Nauk Avenue in Bangkok.

Why did we know this letter was from **Bazil Zingali**? The note reads, "Recently retired from AT&T. Presently living in the lap of luxury, expect to be broke soon. Please send money! Razzle Dazzle Bazil."

If you've been thinking about your very own "field of dreams," then this note from **Charles Blaney** is just the ticket. He writes, "I relived my varsity baseball days by attending the 1991 Red Sox Exchange Fantasy Camp. Pitched a total of 10 innings, won a game—better than MIT! Just had a great time with fellow baseball fanatics and past Red Sox players. Recommend this highly!" . . . Dream on until next month's column.—**Mike Brose**, secretary, 1619 Greenleaf Blvd., Elkhart, IN 46514

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Please send news for this column to: **Allan S. Bufford**, secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

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The secretary apologizes to our class president, **Jorge Rodriguez**, who was inadvertently referred to by the wrong name in our last column. Also, please note that the captions on page MIT 31 of the same issue were inverted. **John Beckett** writes

from Elyria, Ohio, that he is still running the family business—manufacturing oil burners for residential and commercial heating. Not having his hands full with his six children (and a grandchild), John has started two new manufacturing businesses, one making components for gas appliances, the other blower wheels for air moving. John and his wife Wendy celebrated their 30th anniversary in August 1991. . . . From Newport, R.I., comes word that **George Kirk** is now director of the Newport Hospital while continuing as president of The Eppley Laboratory. . . . Also, **Walter Niessen** has been promoted to senior VP of Camp Dresser & McKee, Inc., in Cambridge, MA.

Robert Rothstein tells us that he spent the 1991 spring semester organizing visits of his UMass/Amherst faculty colleagues to the Massachusetts State House to promote the importance of public higher education. Bob urges classmates to join him in speaking out on the issue. . . . In his response in the Class Notes portion of the Alumni Fund form (two hints from your class secretary and agent), **Dave Straight** writes from Stamford, Conn., that he is currently managing equity portfolios for the IBM retirement fund. Dave is still riding an '82 Harley, tinkering with a '47 Chevy pickup, and field-trialing pointers. His wife Judy is busy with her freelance photography business. . . . **Joe Verderber** writing from Kettering, Ohio, says that he has recently accepted the position of president of Tera-dyne Laser Systems, Inc., and VP of its majority holder, General Scanning in Watertown, Mass. Thus, he and his wife Anita are planning a move to the Boston area. Looks like Joe is repeating a move he made 35 years ago.

Congratulations are in order to **Charles Cushing**, who has been elected a fellow of the ASME. Charles is president of C.R. Cushing & Co. of New York and was cited for his achievements in ship design and building. Among his many development and engineering contributions were the container ship concept, portable power for refrigerated cargoes, shipboard gantry cranes, and the design of a pipe-laying ship capable of laying 24-inch diameter pipe at speeds of three knots. . . . In the May/June 1991 column, I wrote that **Sam Gorowitz's** book, *Drawing the Line*, has been receiving critical acclaim. Those of you who listen to late-night radio, like I, may have heard Sam as a guest of Larry King on May 27. We hope that the book continues to do well, Sam.

Sadly, I report the death of **Alan Bloom** in February of this year. Alan is survived by his wife Joy, who lives in Denver, Colo. Alan was a graduate of Course XV and a member of AEPI.

Finally, the MIT provost has made the first award of 1960's Endowment for Innovation in Education to Professor Arthur Steinberg. Professor Steinberg is an associate professor in the School of Humanities and Social Science and director of the Integrated Studies Program. The Class of 1960 Fellow Award is for \$40,000 and is to be applied to the Integrated Studies Program (ISP). The ISP, as described in the MIT Spectrum and as reported in the August/September 1991 issue of this column, is an alternative program for "tinkerers" that helps deepen freshmen's understanding of science's role in society. In the letter announcing the award, **Jorge Rodriguez**, our class president, also writes that the provost is planning an award to a second class of 1960 fellow before the beginning of the 1991 fall term. (I'm writing this in late June.) This second stipend will also be \$40,000. I will keep you posted on the use of our endowment.—**Frank A. Taparo**, secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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Last June brought a peaceful 30th Reunion. Attendance was impressive; over 150 people showed up. Two rumored speakers didn't turn up for the Friday night dinner at the MIT museum.

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John Sununu was still grounded by the president. If the weekend were held in May we would have been O.K. The other potential speaker, **Bill Lenoir**, class astronaut, was busy nursing a delayed Shuttle flight. So we spent the evening talking to one another. We all got a taste of the cruise ship life the following night when we circumnavigated Boston Harbor on a peculiar boat on which the waiters and waitresses took time between courses to sing Broadway songs off-key. Living groups tended to stick together and all the things that are supposed to happen at reunions happened.

Charlie Ruttenberg didn't make it that weekend but was in Boston a couple of weeks later and brought me up to date on his activities. We wandered around MIT one sunny afternoon. He hadn't been back for 25 years and was struck by how little had changed. Charlie went to law school at American University in the late 1970s. His wife, Rhoda, was in medical school (George Washington) at the same time. With two young daughters it must have been quite a feat. He got a law degree, she an MD. Now Charlie is an attorney at the National Labor Relations Board commuting into D.C. from Silver Springs every day. One daughter, Judy, is at Michigan and the other, Miriam, works in New York, while preparing to enter American University Law School in the fall. Charlie had a heart attack last fall which scared him and he has lost quite a lot of weight since. Now he looks svelte and healthy.

Fred Schmidt is a paragon of virtue, handsome, good to his family, and writes to his class secretary frequently. A truly great man. He sent me the last couple of his fascinating Christmas letters. These days Fred works for the Navy in the Air Systems Command in D.C. But for most of his career he was with the CIA keeping his eye on the Soviet Union. A year ago he and his son, Erik, went to look at the last of the Berlin Wall and included in his letter a sample of the wall. Thanks Fred. He also sent a curious set of pictures with his son at the Soviet Border where they were stopped by a couple of Polish soldiers. Fred was able to keep them at bay with three cans of Coke. I wish I could excerpt more of his wonderful letter. He is a terrific writer.

I hope you all put me on your Christmas (Hanukkah) address list. It's a good way to keep your friends informed of your doings. Also, it's easy for you to find my address. It's right here: **Andrew Braun**, secretary, 464 Heath St., Chestnut Hill, MA 02167

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The Computer Law Association, an international association devoted to educating lawyers on the unique aspects of computer technology, has elected **Oliver R. Smoot** of Washington, D.C., as its new president. Ollie had previously served as vice-president of the association. He continues to work as executive vice-president and treasurer of the Computer and Business Equipment Manufacturers Association in Washington.

Murray B. Sachs received a \$3 million, three-year grant from the National Institutes of Health to establish a comprehensive program for the study of hearing, balance, and related problems at Johns Hopkins University. Murray serves as professor of biomedical engineering and director of the Johns Hopkins School of Medicine Hearing and Balance Center. In a news release from Hopkins, Murray is quoted: "Over the past 10 years, there has been an explosion in our understanding of the basic mechanisms of hearing and balance. But we've made little progress in applying these results to solving clinical problems. In the Hearing and Balance Center, interaction between basic and clinical scientists will be the rule rather than the exception."

Harvey E. Cline and three of his colleagues from the General Electric Research and Development Center in Schenectady, N.Y., were named 1991 "Inventors of the Year" by Intellectual

Property Owners, Inc. (IPO). They will share a \$5,000 cash award from the Intellectual Property Owners Foundation, the educational arm of the IPO in Washington, D.C. The GE team developed a new method of "seeing" blood vessels in the body called Phase-Contrast Magnetic Resonance (MR) Angiography. The invention's applications include helping to diagnose and treat strokes, aneurysms, and other life-threatening cardiovascular system diseases. Harvey is a 25-year veteran of GE Research and Development and is a winner of the GE R&D Center's highest honor, the Coolidge Fellowship Award. He holds 125 U.S. patents in electronics, metallurgy, lasers, and three-dimensional medical imaging and has published 120 technical papers on his research.

We were saddened to learn of the death of classmate **Charles Richard Rein** in Pearl River, La., on February 12, 1991. He was a native of Gretna, La. Charles was a mechanical engineer working with the Naval Oceanographic and Atmospheric Research Laboratory at the Stennis Space Center. He died of cancer, and his family requests that any memorial contributions be made to the American Cancer Society, North West Office, P. O. Box C-19140, Seattle, WA 98109-1140.

A careful reader of the *New York Times* found a guest editorial by **David H. Koch** on March 7, 1991. It seems that Dave was aboard the U.S. Air Flight 1493 that collided with a SkyWest commuter plane at the Los Angeles airport on February 1, 1991. Dave had several constructive things to say about needed changes in the design of passenger aircraft: divide emergency overhead lights into zones to avoid total failure of the emergency lighting system, add more window exits, individually illuminate emergency instructions on the emergency doors, and protect passengers from smoke and toxic fumes. Since we have several classmates active in aircraft and aerospace design, perhaps Dave's suggestions can be used constructively to save lives and protect airline passengers in the event of future tragedies such as the one that David survived.

Carl Wunsch is about to undertake a project to measure oceanic temperatures on a global scale. Supported by federal research funds and the loan of a naval ship, Carl, chairman of the MIT Department of Earth and Planetary Sciences, and his colleague, Walter Munk, of the Scripps Institution of Oceanography, will generate a loud noise beneath the surface of the Indian Ocean and then attempt to measure the sound waves as they reach California and Bermuda. The technique, acoustic tomography, works on the basis that sound waves travel faster in warm than in cold water. The compressional wave research technique has applications in the study of global warming.

Juan J. Calvo has been named executive vice-president, Finance and Corporate Development Division, C. A. Venezuela de Pulpa y Papel (VENEPAL). He was elected to the board of directors of VENEPAL on December 19, 1990. VENEPAL is one of the largest pulp and paper producers in South America.

We are now planning for our 30th reunion and would like to see you all in Cambridge in June 1992. Meanwhile, please send your class news to: **Hank McCarl**, secretary, P. O. Box 352, Birmingham, AL 35201-0352

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This is of course the age of instant electronic communication, isn't it? My son will spend (has spent, when you read this) the summer in Germany doing research. Thus for economy and speed we will communicate by electronic mail. On the other hand, you are reading the October issue, and are about to read a note attached to a donation and forwarded to me that is dated April 15. **Michael Lukas**, who lives in Eastlake, Ohio, has become director of Engineering for Wisdom Systems. This Cleveland software company does

knowledge-based systems to automated design and manufacture of semi-custom products.

Woody Bowman tells us what everyone who reads *Time*, *Newsweek*, or the *National Inquirer* already knows: he did not get elected controller of the State of Illinois. Instead he is now chief financial officer of Cook County. This is a job that is better, he reports, because it includes not only the bean-counting functions of a controller but also budget and purchasing functions. And he does not have to commute to Springfield. Best of all, he will never again send us any more letters asking for contributions. He does thank those classmates who did contribute in the past. Now I ask you, friends, do you believe that a man of about 50, a life-long seeker of electoral office, and a Republican to boot, can credibly renounce politics forever? We shall see. Meanwhile, good luck in your new job, Woody.

Bill Barnett has moved to St. Louis, where he is professor of economics at Washington University. . . . **Steve Evans** has never before written a full letter to this column (in almost 30 years), but finally did. In the May/June issue there was a spotlight article about Larry Lidsky, who was in the controlled-fusion group. Steve did his bachelor's and graduate theses in this group, and recalls many heated discussions because of the political implications of the work. Steve is now director of Advanced Technology Programs at Rockwell's Rocketdyne division, and is involved in rocket propulsion planning at the highest levels. His oldest daughter, Jan-Marie, has graduated college and is working and married. His other daughter, Diana, is nearing graduation, if Steve's bank account holds up. He and his wife of 28 years, Sheila, "still enjoy California after 26 years." They live in West Hills.

Mike Maul of Pottstown, N.J., is still with AT&T/Bell Labs, where he went after graduating 23 years ago. He is responsible for integrated-circuit design centers in Allentown, Pa., Sunnyvale, Calif., Taiwan, Singapore, Japan, Madrid, Munich, and London. During one recent seven-week period he visited all seven! His wife June (Paradise, '67), who has reported Mike to the police as missing, is also a manager with AT&T. They have seven horses, three dogs, and five cats. Mike has recently gotten into long-distance endurance (his or the horse's is not clear) horseback riding, including galloping through the redwoods of northern California.

Now to the press releases. **Malcolm Beaverstock** is VP-Advanced Technology at Automation Technology in Mobile, Ala. . . . **Howard Leibowitz** has joined Nabisco Brands, Inc., of East Hanover, N.J., as VP-Engineering and Operations Planning. He can get us all the Oreos, Chips Ahoy!, Wheat Thins, and Ritz crackers we can eat. Watch your diet, Howard. . . . Finally, **Gary Slep**, former president of the Boston chapter of the American Society of Safety Engineers, has been honored by ASSE as regional safety professional of 1991. Congratulations, Gary.

Folks, if you are honored in such a way, please drop us a note to tell us a bit more detail to pass on to classmates. Thanks, and au revoir!—**Phil Marcus**, secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (301) 750-0184, Internet: 72047.333@compuserve.com.

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Once again, I regretfully begin the column with news of the passing of a classmate. Late in April, **Tom Cheek** died of cancer at the age of 49, leaving his wife Susan and two sons, Brian and David. Tom earned an SB and SM in Course VI, as well as an MBA from the University of Portland. He had a strong entrepreneurial bent, having founded his first company, Beaver Research, while still an undergraduate. After graduation, he cofounded Computer Displays, Inc. of Waltham, Mass. In 1982, he was a cofounder of Xyvision Inc. of Wakefield, Mass., a manufacturer of computerized publishing systems. In 1987, he found

ed Novagraphics, a consulting firm in Woburn, Mass. Most recently, Tom was involved in starting Gamma-Graphx, a print-on-demand systems company in Woburn. He was also active in the Society for Information Display, serving on planning committees at the local and national levels. I'm sure you all join me in extending condolences to Tom's family.

Jim Monk has been appointed president and CEO of Trigen-Nassau District Energy Corporation in Garden City, N.Y., a subsidiary of Trigen Energy Corp. As president of Trigen-Nassau, Jim will oversee all of the company's operations, including start-up of a new \$80 million, 47-Megawatt gas-fired cogeneration and heating/cooling facility. Jim's previous management experience includes positions with Esso Eastern Inc., Arthur D. Little, Inc., New England Electric System, Boston Edison, and TBG Cogen Partners.

John Shaner has been chosen as a fellow of Los Alamos National Laboratory—a top honor that recognizes Los Alamos researchers for outstanding contributions to their scientific disciplines. John is a pioneer in shock-wave physics. During his 20-year career he has led groups that received national acclaim for their work in shock-wave and high-pressure science. John has also directed research that changed the course of international high-pressure science. In 1988, he joined the U.S. delegation in Geneva to provide his expertise on shock-wave physics to the Threshold Test Ban Treaty Negotiations limiting the size of nuclear test explosions. Congratulations and best wishes to Jim and to John.

Please send along news of your accomplishments, activities, or whatever.—**Joe Kasper**, secretary, RR 2, Box 4, Norwich, VT 05055

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Andrea Knutson called to remind me that **George and Regina Hertzlinger** had just celebrated their 25th wedding anniversary earlier this year. Andrea and her husband Donald ('63) were there along with **Ken Brecher** from our class. Andrea is still at Citibank working in their credit-card MIS area. Her major accomplishment of the last year was losing 38 pounds (!). In June she went to California to her son Allen's graduation from CalTech. Her other child is 7-year-old daughter Miranda. . . . Back to George and Regina. George started Belmont instruments 10 years ago to produce cardiac assist pumps. Regina is a professor at the Harvard Business School. She likes to brag that she was the first woman to be awarded a full professorship at the Harvard Business School through the normal tenure process and the first to teach in the school's Executive programs.

Dave Crawford called to extol the virtues of his latest start-up. Dave is establishing a U.S. representative company, Digiflow Systems, to market and eventually manufacture a high-performance flowmeter that was developed in Holland and can precisely measure the flow of liquids in low-flow applications. Dave was finally married two years ago. His wife Julia teaches physical education. . . . **Vinod Jhunjhunwala** reports his son Uday will enter MIT as a freshman this year and his daughter Ranjini is on her way to Yale for law school. Vinod has recently set up a metalizing printing unit for flexible packaging in India.

Ted Young writes from the Netherlands to say he is still at Delft University teaching applied physics. He recently won a teaching award (for lectures in Dutch!) and the Schlumberger Foundation Research Prize. His wife Mieke is on the executive board of the local school and teaches quilting as well. His daughter Heather graduated from Skidmore with honors in psychology, and his older son Aaron is now in pre-med at the University of Southern California. His youngest, Michael, is in grammar school and recently played in the local theater company's production of *Macbeth*.

Barbara Vickers is still the town tax collector in Hollis, N.H. After MIT, she edited mathematics textbooks at Houghton-Mifflin, and then began raising a family. Her sons are 12 and 16 now. Barbara has continued to do free-lance editing as well as her tax-collection job (it's really easy, she says, you just have to be sure everything balances—wish she did our accounting!). Sounds to me like Barbara is about to re-enter the full-time editing market or set up her own accounting firm. Good luck.

One of my MIT friends sent me a cartoon from *The Tech* about the 1991 Steer Roast at Senior House. Seems MIT's new president, Charles Vest, didn't know about the Steer Roast (which has become an MIT tradition) and held a party at the president's house the same day. Apparently he took the resulting disaster in good stride. **Charles Frasier** and I certainly had no idea we were starting a tradition back in 1964, but disrupting the president's calm life has always been a Senior House tradition!

We successfully saw our younger daughter Susan graduate in the football stadium at UMass/Amherst. Given the state of Massachusetts finances, we began to wonder if the school would stay open! Susan is moving to Seattle, and our older daughter Jeanne is entering graduate school at Berkeley. . . . Do write.—**George McKinney**, secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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Please send news for this column to: **Jeff Kenton**, secretary, 7 Hill Top Rd., Weston, MA 02193

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Mike Zuteck writes that the National Academy of Sciences will publish this year the research report, "Assessment of Research Needs for Wind Turbine Rotor Materials Technology," on whose committee of authors he served. Given the need to curtail carbon dioxide production and global warming, Mike hopes this volunteer effort will make a useful contribution toward furthering renewable energy-generation technology. Mike's regular consulting business has also been keeping him busy. He works on projects with Hawaiian Electric Renewable Systems and a major Danish wind turbine manufacturer, in addition to the ongoing advanced wind turbine projects for the Department of Energy. For the time being, speed sailing and Tornado catamaran racing have had to be put on hold. . . . **Dave Sanders** continues to be with Hewlett-Packard in Roseville, Calif., near Sacramento. Most recently, he has been general manager of the Data Management Systems Division, responsible for Hewlett-Packard's data base software, as well as software which integrates PC's with HP minicomputers. As their children (John, 14, and Ann, 12) approach high school age, Dave and Jan continue to enjoy skiing and water sports in the nearby Sierras. . . . Since leaving MIT in 1968, **Larry Galpin** has been living and working in Wilmington, Del. He is currently commercial director for fluoropolymers for ICI Americas in Wilmington.

After leaving with a SB in chemical physics, **Brad Cross** moved to California and received an MS in physics from San Diego State College and a PhD in physical biochemistry from U.C. Santa Cruz. He then joined the International Atomic Energy Agency in Vienna where he has been working in mainframe computing, most recently for nuclear material safeguards. In January, Brad was elected general secretary of the Federation of International Civil Servants Associations and has moved to Geneva for the duration of his term. . . . **Jeffrey Stamen** is now group president for Information Resources Inc. of Waltham, Mass. . . . **Ruth McDowell** is the author of a new book entitled *Pattern on Pattern*, recently published by the Quilt Digest Press, in which she describes



On Technology Day last June 7, Paul Rudovsky, '66, reunion gift chair for the 25-year class, presented \$1,266,000 to MIT, with a record 76 percent class participation.

her quilt making work methods. Ruth took the plunge and decided to make a living at quilt making. Her quilts are known throughout the world, and she has taken them on lectures to Austria, Denmark, Switzerland, Germany, and Japan. She notes: "In Japan, there are rigid schools where you work under a sensi, or master. But here, in America, quilting is a salvage art, a home art. It's a creative thing women could always do, as they cooked the food and tended the babies and boiled the clothes."

Alan Perelson is one of five scientists chosen as Fellows of Los Alamos National Laboratory, a top honor recognizing Los Alamos researchers for outstanding contributions to their scientific disciplines. Alan specializes in theoretical and mathematical biology with an emphasis in theoretical immunology. He has edited or written eight books and published more than 100 articles on biological subjects. Alan is an external professor and member of the Science Board of the Santa Fe Institute, a private research institute devoted to studying problems in the sciences of complexity. He also serves on the editorial boards of seven journals. . . . **John Reynolds'** daughter, Christine, graduated from MIT in June with the Class of 1991. . . . **Dan Schwarzkopf** reports: "I am not related to 'Stormin' Norman' but have received phone calls from people who think I am." . . . **Gordon Lee** says, "Really enjoying second marriage and second-time parenthood with our two-year-old son Brandon." His first two children are grown, and one recently married. Gordon and his wife Miwon live in Seattle and are both mainframe computer consultants. . . . I thank **John Rudy** for material for this month's column and also for leading the efforts in organizing our upcoming 25th Reunion.—**Jim Swanson**, secretary, 878 Hoffman Terrace, Los Altos, CA 94024

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In a bold bid to win the contest for couple with the youngest child at the 25th reunion, **Anne and Bill Carlson** have announced the birth of their first child, Ripley John, on May 3 who weighed in at 8 lbs., 14 oz. Their note adds, "The baby is thriving, the parents are awed, and the world seems to have shrunk down to our nucleus of love, which we would like to share with you." . . . We received a note from our northernmost alumna, **Charlotte Babicki**. She says she has discovered that political science is not as "useless as it seems," as her job of writing manuals has now been redefined and she has become the senior policy advisor for the Department of Government Services in the government of the Northwest Territories. Charlotte has been living in Yellowknife for many years, and we note that urbanization

must be coming since for the first time she has used a street number in her address, not just Yellowknife, NWT.

Bob Metcalfe reports that he retired in June 1990 from 3Com Corp., the \$400 million computer networking company he founded in 1979. Bob and Robyn now have two children, Julia (4) and Max (2). Bob has become a writer and consultant, working on a book about his invention, which he says will probably not be called *Ethernet versus Godzilla*. In September, Bob went to the "real Cambridge" (UK) as a visiting fellow in the computer laboratory. They plan to return stateside before 1993, in time for Ethernet's 20th birthday and our 25th reunion. . . . **Robin McGuire** has been elected president of the Seismological Society of America for 1991-1992. He continues in his position as president of Risk Engineering, Inc. in Golden, Colo. . . . Back in beantown, **Aviva Brecher** writes that she has been with the DOT/National Transportation Systems Center for nearly four years working on a range of advanced transportation systems technologies, from mag lev trains to commercial launch safety. She has also been serving for four years now on the AAAS Committee on Science, Engineering, and Public Policy, trying to get more scientists involved in affecting policymaking decisions.

Closer to home, **Stephen Straus** has been appointed chief of the Laboratory of Clinical Investigation of the National Institute of Allergy and Infectious Diseases, part of NIH. His personal research is now focused on molecular biology, pathophysiology, natural history, treatment, and prevention of herpesvirus infection. We also appreciate his work with us on the MIT Educational Council. . . . From Princeton, **Barton Rothberg** writes that he is living there with his wife, Carol, and their two children. After graduating, he studied at a nearby school in Cambridge and "worked at sundry jobs." He now speculates in the commodities markets at Commodities Corp.

George Owen writes that he has joined the Milwaukee Architectural Group of Howar Needles Tamman & Bergdork as their senior project manager. HNTB is a nationwide firm specializing in transportation and environmental engineering as well as architecture. He specializes in renovation and community design. . . . From Worcester, **George Phillis** announces that he has reached the top ranks of academia as professor of physics. . . . **Michael Riordan** has co-authored a new book, *The Shadows of Creation: Dark Matter and the Structure of the Universe*. Previously he had been awarded the American Institute of Physics Writing Award for his book, *The Hunting of the Quark*, based on his work on early electron scattering experiments that led to the discovery of the quark. He also co-authored *The Solar Home Book*, a best-selling guide to solar home design. He is the science information officer at the Stanford Linear Accelerator Center but has been working for a year as staff scientist at Universities Research Association. . . . That's all we have for now. Remember, see you in Cambridge for the 25th reunion in 1993!—**Gail and Mike Marcus**, class secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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Tim Casady graduated in June from the Santa Monica College registered nursing program. "Believe it or not," he writes, "it was almost as hard as MIT!" Tim and his wife Karen were expecting their first child in July; they had "inside" information that it would be a boy. Tim plans to work in the Eye Surgery Dept. at St. John's Hospital. . . . **Michael Underhill** has relocated from Iowa to Phoenix, and has taken a new position as director of the School of Architecture at Arizona State University. He says that he will soon move his practice here from Houston. . . . **Douglas Frost** has held a joint appointment since September 1988 as an associate professor of neuroscience at Harvard Medical School and Massachusetts

General Hospital; he is "enjoying living on the beach in Marblehead."

Lt. Col., USAF, **George Slusher** is now director of Missile Launch Analysis for the Strategic Missile Center at Vandenberg AFB, Calif. He writes, "We do the analysis of data from the Strategic Air Command's operational tests of both Minuteman and Peacekeeper (MX) missiles. I am occasionally teaching at West Coast University, a 'working person's university.' Just went over 20 years in the Air Force." George is district commissioner of the Santa Ynez Valley Pony Club and a new member of the Board of Governors of the United States Pony Clubs, Inc. . . . **Henry I. Miller** has been the director of the FDA's new Office of Biotechnology since 1989. He moved into a new home in Bethesda, Md., in December 1990.

Roy W. Haley is now president of American General Corp. in Houston, having previously been executive VP. . . . **Denis A. Bovin** is now senior investment banker at Salomon Brothers, Inc., in New York City, having previously been managing director. . . . **Jeffrey D. Tranen** has been elected VP of the New England Electric System (NEES), a public-utility holding company in Westborough, Mass. Jeffrey had been a VP of New England Power Company (NEP), the wholesale generating and transmission subsidiary of NEES.

Speaking of electric power, my book on the cold fusion controversy, *Fire from Ice*, is now in book stores, electrifying folks everywhere with the news that cold fusion is *indeed* real. Skeptics, read it and weep! . . . In early June, I left my position as chief science writer at the MIT News Office to become a full-time author and engineering consultant. I tendered a lengthy resignation letter in which I wrote, "I feel increasingly uncomfortable being the ex officio representative of the tragic and indefensible abrogation of academic standards that has occurred at MIT in this [cold fusion] matter." Want details? Write to me.—**Eugene F. Mallove**, secretary, 171 Woodhill-Hooksett Rd., Bow, NH 03304

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Michael Hurst writes: "I started a new family three years ago with the former Renee Sanloff and we now have an 18-month-old daughter (Rachel) and a six-month-old son (James), in addition to my 12-year-old daughter, Michelle. It sure is different in your forties! My company, Hurst Associates, provides employee assistance programs to 40 companies and 90,000 employees, primarily in New England, and now is joint venturing an integrated EAP-managed health care product nationwide (ValuePlan)."

Jesse Heines reports that he is an associate professor of computer science at the University of Massachusetts in Lowell and is an active consultant in computer-based training. His two sons, Scott and Russell, turn 16 and 13, respectively, this year. In his spare time, Jesse enjoys scuba diving for lobster and underwater photography. . . . **Robert Moore** tells us that he is currently the director of the Natural Language Research Program at SRI International in Palo Alto, Calif.—**Greg and Karen Arenson**, secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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Our new class president, **Delmar J. Knarr, Jr.**, called me about the reunion. About 55 classmates attended with their guests and had a great time. Our new class officers are: **Robert N. Schulte**, vice-president; **R. Hal Moorman**, secretary; **Dale Schain Krouse**, treasurer; **Robert D. Terwilliger**, reunion chairman; and **Zane L. Swanson**, class gift coordinator.

Our 25th reunion is in five years, and planning is already in process. Your officers solicit your cooperation, coordination, and participation. We need your ideas, your money, and your en-

thusiasm. Our class has not been among the big givers in the past and we would like to change that.

Avi Ornstein reports that he will be obtaining a master's degree in science education at Central Connecticut State University. . . . **Stanley K. Gilbert, Jr.** writes: "My army reserve unit was activated in December 1990, and I have just returned from three months in Saudi Arabia where I served with a unit handling refugees in Iraq. I am looking forward to resuming civilian life and reopening my private practice in orthopedic surgery." . . . **Rene Haas** writes: "Wife Sharon, children—Jason (8), Christopher (5), Suzanne (2)—and I are doing well in New Jersey. I founded a small software company 14 years ago and took it public in 1987. I am still with the same company, but now, through acquisition, part of a multi-billion dollar conglomerate, RACEL. Quite a culture shock, but still having fun." . . . **Mahdi Jazayeri** writes: "I am on a two-year assignment in Pisa, Italy, to manage a joint research project in parallel processing between Hewlett-Packard and the University of Pisa. It is fun and exciting to experience a very different lifestyle. My two children have learned Italian quite easily—it took about six months."—**R. Hal Moorman**, secretary, P.O. Box 1808, Brenham, TX 77834

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20th Reunion

Some of you who have contributed notes in the past may wonder what happened to them. I say this because my April column (which was mailed the end of last year) went to Cambridge, England, instead of Cambridge, Mass., for some unknown reason. It finally made it to the Tute too late to even make the summer news, but here it finally is, along with some additional news. Normally lead time is not so long, although the whole process does take a fair amount of time.

Terrill J. Chang has joined Camp Dresser & McKee as an associate and senior solid waste specialist in their Detroit office. He is managing the siting and design of a medical waste incinerator and services during its construction in Oakland County. . . . **David C. Harlan**, formerly vice-president of marketing for Louisiana Power and Light Co., has assumed the post of bulk power marketing officer for Entergy Corp. . . . **Robert Schulte** is a software market consultant at the Gartner Group in Stamford, Conn.

Alan Michael Cooper and **Liz** continue to live in Lynchburg, Va., with their 2-year-old, William, and their daughter, Elizabeth, who was born in September a year ago. He is starting his sixth year of full-time public sector psychiatry "trying to balance the rewards of caring for the sickest against the frustrations of working in a progressively less responsive bureaucracy." . . . **Thomas A. Weiss** is now the state engineer/environmental coordinator for the FHA in Montpelier, Vt. . . . **Lawrence S. Bacow** has been appointed the head of the Center for Real Estate Development at MIT. He also received the 1990 William S. Ballard Award from the American Society of Real Estate Counselors for his article "Foreign Investment, Vertical Integration, and the Structure of the U.S. Real Estate Industry."

Steve Gass was recently named head of the Engineering Library at Stanford University. . . . **Glenn Rowsam** is working for the State of New York, implementing a UNISYS office automation system (OFIS Link) in the Department of Social Sciences. He has a year-round involvement in the OC (Out of Control ski club). They have 1,000+ members and he is handling the members/applicant committee this year after running elections last year.

Robert Fourer is in his second year as chairman of the Department of Industrial Engineering and Management Sciences at Northwestern University. He notes, "It is a thankless job, or so everyone tells me." . . . **Harlan Ives** is an associate professor of medicine and chief of the Nephrology Division at UC/San Francisco School of Medicine.

He and his wife Shelley live in San Francisco with their two daughters, Rebecca and Samantha. Rev. **Robert D. Williams, Jr.** reports that his wife is completing her medical residency but neglected to give any news of what he is up to.

James Czajka is an associate at Beyer Blinder Belle, Architects. In early May he gave a speech to a group of New York City alumnae about the work his firm did on renovating Ellis Island. Then he helped lead a tour of Ellis Island that was quite interesting.

I got to see classmates **Carliss Baldwin** and **John Gunther** recently. Both are busy with work and kids, but enjoying both.

That's it for this month's news including those from last winter. Hopefully this column will make it's way to Cambridge without a problem. Please send us more news.—**Wendy Elaine Erb**, co-secretary, 6001 Pelican Bay Blvd., Apt. 1003, Naples, FL 33963

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Eddie Lee has spent the past 17 years developing the family business in the Ivory Coast. With two elder sons in boarding school in the States, he has decided to return this year and is looking for investment opportunities such as a start-up needing financing. . . . **William Stohl** announces the birth of a fifth child (third daughter) Nina Hilary last October.

Kamil Tulga and wife **Esra** are raising their son **Ali** in Istanbul, Turkey. He is president of TMT, Ltd., which installs intelligent electronic building systems in Istanbul and Ankara. . . . **Jim Foran** is manager of advanced graphics hardware for Silicon Graphics in Mountain View, Calif., and intends to have backpacked in Wyoming with **Matt Goetz** this summer.

Yours truly's current quartet, Main Street, finished fourth in the D.C./Virginia state contest to qualify for the Mid-Atlantic contest in Ocean City in October. The Alexandria Harmonizers won the chorus contest going away, on our way to a hopeful third International Championship. Incredibly, I stand on the risers right next to **Marty Romeo**, and the odds of two guys out of the same MIT class crossing paths that way are pretty slim. Write.—**Robert M.O. Sutton, Sr.**, secretary, "Chapel Hill", 1302 Churchill Ct., Marshall, VA 22115

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Life doesn't begin at 40, only the best part. I was talking to **Marty Davidoff**, who has recently gone back into business for himself (accounting), about this topic. He says that reaching 40 means it's time to reap the benefits, since we've spent 20 years learning in the College of Hard Knocks. My father, however, had the best advice I've heard yet on hitting the Big Four-Oh: "It's only a number."

Tom Wegert has been promoted within Coopers & Lybrand, from manager in their New York office to director of their Chicago office's resource management practice. Tom, Ellen, and their two daughters, Elizabeth and Katherine, live in Winnetka. . . . **Leonard Guarente**, associate professor of biology at MIT, recently received a two-year research grant from the American Cancer Society. A sum of \$180,000 was awarded to him to carry out his studies of transcription (growth) activity of eukaryotic cells.

"Following a six-year stint as a professional baseball umpire in the minor leagues," writes **Larry DaGate**, "I have been an attorney with Lemle and Kelleher in New Orleans for the past five years. My areas of practice include commercial litigation, lender liability, and business bankruptcy." . . . **Kevin Krauklis** was appointed president of FlowLine Alaska in December 1990. . . . **John Mack** is currently administrative officer at the U.S. Embassy in Algiers, Algeria. He was recently named the worldwide winner of the

State Department's EEO award for 1990.

Robert Minshall writes to say he is currently a video tape editor at Unitel Video in Los Angeles. He's been working on a variety of commercials, music videos, and several television productions. He's also playing semi-pro baseball (in his spare time?), and he and Joanna have a son of four, named Matthew. . . . **Edwin Arippol**, writing from Milan, says he has been living in Italy now for nine years. He and his wife, Tina, have two children, Leonard and Rebecca, as well as son Maurice from his first marriage. "Business has not been great for the past three years, and it is probably time to move on to something new, possibly back in the U.S."

Rounding out this month's column is an update from **Abbie Gregg** in Tempe, Ariz. Abbie is an engineering consultant working in the semiconductor industry. Her husband, Rand, is an engineer at Motorola. They have two daughters, Joanne and Hillary, and they love living in the sunny Southwest.

Have a fall fall.—**Lionel Goulet**, secretary, 115 Albemarle Rd., Waltham, MA 02154-8133

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Here's the news: **Bruce N. Davidson** received a PhD in public health with a specialization in health policy studies in March 1990. His dissertation was entitled, "Consumer Information and Biased Selection in Medicare—A Study of the Effects of Public Policy Remedies in a Market with Multiple Information Deficiencies." He recently completed one year as a manager in the Health Policy Research Division at Systemetrics/McGraw Hill. . . . **Thomas B. Higgins** and his family are enjoying living in the Pacific Northwest. He would like to hear from any MIT structural engineers/programmers interested in collaborating on some "copylefted" software for building design. His number is (206) 573-7729. . . . And this from **David Jessich**, "Whew, I survived the Gulf War and 13 SCUD attacks on Dhahran. I hosted over 1,000 U.S. soldiers and airmen at my house for home-cooked meals and hot showers. Recently, I met classmate **Ray Izor**'s sister-in-law who is serving as an army nurse. We thank God for the quick end to the war!"

Ramon J. Vallejo has been with Shell Oil Co. for 15 years. He was recently promoted and transferred to Shell Offshore, Inc., in New Orleans and will be the health, safety, and environment manager for Shell's Coastal Division. Ramon is married and has three children—Jay (8), Lizette (7), and Luis (3). . . . **Stan R. Roth** and his wife, Eileen, had a baby girl, Renee, on September 20, 1990. All are doing well. Stan continues at Eastman Kodak where he is a senior engineer in process design. . . . **George E. Gerpheide** is president of Cirque Corp., which develops, manufactures, and markets disk array systems using innovation image compression technology.

And, finally, I share with you **Caryn Navy** and **David Holladay**'s announcement of the adoption of their new son, Seth Andrew: "Seth was born on November 21, 1990. Having settled his legal situation on February 21, 1991, Seth decided to live in Madison, Wis. His decision was based on a number of factors. As we understand it, he was influenced by Madison's diverse cultural activities, its excellent schools, its abundance of neighborhood parks, its city-wide recycling program, and its unparalleled lawyer-to-people ratio. And he was astonished to find out that a small city like Madison could support three diaper services."

"He wants everyone to know that he is doing well (he currently weighs 15 pounds and is 26 inches long). He is also pleased to announce that the training of his new parents is almost completed."

That's it for now. I look forward to hearing from more of you.—**Jennifer Gordon**, secretary, c/o Pennie & Edmonds, 1155 Ave. of the Americas, New York, NY 10036

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Please send news for this column to: **Arthur J. Carp**, secretary, Voice Recognition Technologies, Inc., 220 Henley Rd., Woodmere, NY 11598; (516) 295-3632, fax (516) 295-3632

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15th Reunion

This month we have plenty of news. Last issue, as I expect you all noticed, this column was missing. Paul and I were visiting the Institute for the inauguration of President Vost around deadline time. We saw **Brian Hughes** from afar in the Great (oops, I mean Killian) Court. I certainly hope the absence of this column inspired many of you to write critical, but newsy, notes to your faithful class secretary.

First, the news from the alumni-cum-physicians contingent. **Thomas Mills**, who is a staff psychiatrist at the VA medical center in San Francisco and assistant clinical professor at the University of California/San Francisco, is getting a master's of public health degree in health policy and administration as well as doing a post-doctoral fellowship in mental health finance and service delivery at Berkeley. He reports that his own health continues to hold up pretty well, despite many years of being HIV positive. He had a trip to Italy planned for this past June. . . . **Steve Buchthal** finished up his program at the University of Minnesota last February and is now at Harbor-University of California/Los Angeles Medical Center in Torrance, Calif. as, chief NMR spectroscopist. He's expecting an appointment as an assistant professor in the Radiology Department.

Cindy Koelker reports that one year ago she started her own private practice in family medicine in Akron, Ohio. Her children are now 2, 6, and 11. She says, "I never see or hear from anyone at MIT and wonder what my friends from

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German House and concert band are doing." So do the rest of us, Cindy. . . . **Kenneth Lazarus** is enjoying a private practice of neurology and neuroimaging in Atlanta as well as trying to recruit a partner. He and his wife Jill had their first child, Samuel Victor, in May 1990, and their second is expected this month.

Jane Brown has a private pediatric practice in Needham, Mass., which keeps her quite busy. Jane's "home" practice is growing as well. Five-year-old Benjamin now has twin sisters, Sarah and Rebecca Stone, born in December 1990. Jane describes her children as "healthy and beautiful. . . [and] a great joy."

Now the scoop on those in the computer business. . . . **Steven Grossman** is still working at Advanced Micro Devices in "Silicon Valley" as director of marketing for memory products. He reports that business is good and that they are gaining market share. AMD is one of the leaders in non-volatile memories, and Steven claims that they are "definitely beating the Japanese."

Richard Korf informs us that he is an associate professor of computer science at the University of California/Los Angeles. . . . **Steven Spura**, who is living in Rhode Island, has started building custom-configured IBM-compatible computers. This is, for now, a part-time venture. In addition to system sales, Steven does consulting. One recent project involved designing and programming a computerized telephone answering system (which is going to Turkey) for a novel application.

Leslie Faye Sutton is still working in the Computer Science Department at IBM's T.J. Watson Research Center. She recently received an IBM Outstanding Technical Achievement Award for work on locking prototypes. She has completed her coursework toward a PhD in computer science at Polytechnic University, which, of course, leaves all the real work left to do! Her daughter, Laurie Kathleen, celebrated her second birthday in April. . . . **Howard Boles** reports that he is still having a great time working at Kronos, Inc., in Waltham, Mass., as a senior software engineer in Major Accounts. His job involves customizing their time accounting software products for individual customers. He writes, "Outside of work, I just finished playing French horn and Wagner tuba in the Bruckner Ninth Symphony with the MIT Symphony Orchestra. It was great playing for David Epstein again—he and the orchestra are still going strong after all these years! My wife Lisa and daughter Bethany are also doing fine. Bethany, who will be 5 by the time you read this, has started on her way to fame and fortune, having begun tap and ballet class at a local dance studio. Watch out, Broadway!"

Jill P. Kern, who is quality applications planning manager with Digital Equipment Corp. in Marlboro, Mass., was elected VP of the publications services of the American Society for Quality Control. Jill is also an instructor in quality and management sciences at Northwestern University. At DEC she is responsible for developing and marketing integrated quality information system solutions to manufacturing industries.

And, for the rest of the news. . . . **Jo Ann Ivester**, who is married to Jon Ivester, 78, has been promoted to manufacturing manager at Applied Materials. She is now working at the same company as Jon, and they and their three children live in Redwood City, Calif. She is also an assistant troop leader for the Brownies. They are undertaking a six-month construction project to add a second floor to their currently two-bedroom home. . . . **Stephan Mallenbaum** and his wife, Suanne Garber Mallenbaum (Wellesley, '82), announce the birth of their baby girl, Zoelle Sara. Stephan continues as a corporate partner in the New York law firm of Carro Spanbock representing high-technology and computer-industry clients.

Last, but not least, is an update from the family of **Marilyn** and **Peter McQuade** in Bothell, Wash. They have three children—Becky, 5, Dave, 2, and Linda, 6 months. I'll let Marilyn relate the rest. "Pete and I went through Air Force ROTC

together at the Institute, spent three years at the Weapons Lab in Albuquerque, N.M., and one-and-a-half years back at MIT for our master's degrees, four-and-a-half years in the Washington, D.C., area, three years at the Air Force Academy in Colorado Springs, Colo., and the past one-and-a-half years in a suburb north of Seattle. While in Colorado, I resigned my Air Force commission to become a full-time mom. Pete is a major now, on an Air Force-sponsored PhD program in computational fluid dynamics at the University of Washington. I guess that pretty much brings us up to date."

It's never too late for you, too, to bring us all up to date. Your secretary is, for a limited time, offering amnesty to anyone writing with an update after an absence in this column of 10 or more years. This program expires at midnight December 31, 1991, so get your news in fast! Write to—**Ninamarie Maragioglio**, secretary, 8459 Yellow Leaf Court, Springfield, VA 22153

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Congratulations are in order for **Jeff Palmer**, who is now vice-president for corporate development at Bolt Beranek and Newman. Jeff and family are living in Belmont, Mass. . . . **Janet Wiedeman**



Janet Wiedeman

was recently promoted to senior consultant in the actuarial, benefits, and compensation consulting practice in the Boston office of Coopers & Lybrand. She joined the firm in 1989. Janet is living in her hometown of Milton, Mass. . . . **Ken Kellogg** writes, "I married Robin Rosenthal (Rutgers '80) in July 1988. Our son, Max Jason Kellogg, was born December 20, 1990."

Harold Furchtgott-Roth also brings us up to date on his news. "I am now working as an economist for Economists, Inc., a firm that provides litigation support for law firms. I have two children, Leon (2) and Francesca (1). In what little free time we have, my wife, Diana, and I enjoy opera, traveling—Portugal and England this year—and gardening. . . . **Scott Golden** says, "My law practice continues to grow and diversify. Likewise, my diversified product brokerage business has grown to nine states and Canada. Jane and I continue to participate in various community, church, and political endeavors, while Jane's music avocation slowly expands. Danny, 8 (piano and Nintendo) and Kimberly, 5 (gymnastics and joie de vivre) are also pursuing their own interests." Scott and family are living in Ft. Lauderdale, Fla.

Howard Runge says, "I have been working at Orbital Science Corp. in Fairfax, Va., for the past three years. I recently began work as the deputy program manager on a program to provide NASA with clean color data that will be obtained using our own small satellite, Pegasus launch vehicle, and satellite ground control station. I just got a 700 cc sport motorcycle to have some fun with on weekends. My wife, Carol, and daughter Cathy (7) are enjoying northern Virginia too." . . . **Geoff Baskin** is still in Washington working on airports for Parsons Management Consultants (on loan from Parsons Brinckerhoff). . . . **Jeff Rubenstein** writes, "I've been keeping busy as vice-president of United Radio and director of engineering at

Cellular One of Syracuse and Utica (New York). Cellular system growth is still accelerating, and keeping up with it is quite a challenge. My wife, Tiny, is expecting six babies this year. . . . horse babies that is, so it's going to be a busy summer for both of us."

From **Kenneth Li**: "Spent several months commuting from California to Boston on a monthly cycle in order to work with my father, Y. T. Li (ScD '38) in his venture to develop his high-performance desalinization process. My second child, Nicholas, was born during that period, making the long-distance commute more difficult. In April, I returned to my previous employer, Varian Associates, to start on a new product for the gas chromatographic market." . . . In January, **Larry Siegel** married Pat Curtis, "a total fabulous California babe." Present at the great event were Brian Torone '80, Roger McSharry '79, Walt Seale '80, **Jim Harrison**, Allen K. Ream, '59, and Bob Siegel, ScD '53. Larry is an assistant professor at Stanford, and Pat practices medicine in Berkeley.

Please send along news of your latest exploits today.—**Jim Bidigare**, secretary, 322 Central Ave., Newark, OH 43055, (614) 345-8582

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Dorothy Comeau and **Jed Fuhrman**, '77, sent an announcement of the birth of Rachel Mirabelle, born March 24 and weighing in at 8 pounds, 12 ounces! They also included a copy of their very amusing Christmas letter from last year. Apparently, Dorothy, Jed, and 2-year-old son Gabriel survived being a two-coast family. Dorothy finished her medical training at Columbia University in New York, with much cross-country travel between New York and Los Angeles for all family members. After her maternity leave is over, she will have one more elective to go (in L.A., luckily) before she graduates in October. She plans to do research for the rest of the year, and then apply for a residency in urology. Congratulations, Dorothy, and thanks for giving me a good laugh!

Speaking of Columbia, **Gail Kaiser** is still an associate professor of computer science there. Her first PhD student defended her thesis in November, and her second PhD graduate will be finishing soon. . . . **Jeanne Brady**, who is "still slaving away at Draper," sends the following message to—well, you know who you are: "Hey, NRSA Buckaroos! A reunion sounds great. But Limp, you know if Boob brings the lobsters, they're bound to get LOOSE—Holy Cow! The Bucketette will be in touch." (I don't make this stuff up, folks, really.)

Martin Aboitiz Uriarte writes, "I am still in our family business, at odds with the Argentine economy. My eldest son says I am a gnu. Will one of you come to visit and tell him he is wrong? My new address: Los Algarubos 1543, San Isidro Chico San Isidro, 1642 Buenos Aires, Argentina. Telephone number: (541) 747-5973." . . . **Beth Marcus** writes from Lexington, Mass., that she was able to send in her Alumni/ae Association dues because her two-and-a-half-year-old company, Exos, raised a round of financing, totaling \$500,000, from MTDC and private sources last year. She now has 11 employees. "Our products are doing well, and our future looks bright." Way to go, Beth! Write and tell us more about your products. . . . **George Glackin** proudly reports the birth of a son, Kyle Davis Glackin, on September 17, 1990.

Back in April, serviceman **Dan Jaime** wrote, "Currently deployed to Saudi Arabia. Hope to rejoin my wife Cathy and our 8 children in Wuerzburg, Germany, very soon. We should be returning stateside this fall." Hope you get to read this from the U.S., Dan. . . . **Ron Mandel** and his wife (a native of Shanghai, China) live in an old Victorian house in Marshall, Mich. He is chief of anesthesia somewhere in Battle Creek but I couldn't read his handwriting to say where. . . . **Dan Jaffe** writes, "In August 1990, I got married to Barbara Bender. We remain active in outdoor

activities. My environmental/atmospheric chemistry research here at the University of Alaska/Fairbanks, is still going strong, with field projects in Alaska, Colorado, and the USSR."

Bruce Baker and his wife Patty had their first child, Cassandra, on January 31. Bruce continues to work as a sales engineer at U.S. West, while Patty is taking off a few months from Virginia Mason Hospital as a planner. The Bakers reside in Seattle. . . . **Sandra Viarengo** writes, "After 12 years, I am still at Intel Corp. in Santa Clara, Calif. I am currently a project manager for Intel's first eight-inch semiconductor fabrication facility. My husband Michael and I just finished a year-long remodeling project on our home in Los Altos. We are looking forward to enjoying our home in relative cleanliness and quiet. News on classmates include **Bob Russo**, who now lives in Caracas, Venezuela, working on a variety of business ventures with his wife Bettina; and **Juan Fernandez**, who is still at Sandia Labs in New Mexico." . . . **Greg George** kept his message short and sweet: "Hello to the Dekes."

Michael Good reports, "This never made it to *Tech Review* last year, so I'll try again. I'm leading the Presence project, Digital's research project in the "virtual reality" area. Plus I'm singing in local theater and choral groups, such as the Sudbury Savoyards and the Arlington-Belmont Chamber Chorus. The latter is directed by John Bavicchi, favorite composer of the MIT Concert Band." . . . **Daniel Weinreb** works in Burlington, Mass., at Object Design, an object-oriented database software company that he founded three years ago. He is pleased to report that, despite the recession, the company is doing very well, and he likes both the work and the people. He and his wife Cheryl live in Arlington, Mass., and were expecting the birth of their first child in September. (So, was it a girl or a boy?)

Roger McSharry was one of the guests at the January wedding of Larry Siegel, '78, to Pat Curtis. . . . **Mansour Sheyagan** has been on the faculty of Princeton University since 1985. He teaches solid-state physics and electronics in the Electrical Engineering Department to both undergraduates and graduate students, and does research on the physics and technology of electronic material and devices. In 1986, he was named a Presidential Young Investigator, and in 1989 a Sloan Research fellow. He earned a PhD from MIT in 1983.

As for your faithful secretary, our Off-Off-Broadway production of the musical *She Loves Me* was a big smash. Consensus has it that it was the best show we have done in years, and I was pleased to garner rave reviews for my performance in the lead. It was a thrilling experience. Work continues to go well. Till next time.—**Sharon Lowenheim**, secretary, 98-30 67th Avenue, Apt. 6E, Forest Hills, NY 11374

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John Kevin Wojahn wrote from Iraq. He is still flying F-16s for the USAF, although he is currently an air liaison officer with the 3rd Armored Division. John says (and I'm sure we all agree), "May peace be with the world for a while." . . . **Russell Blount** writes that his daughter, Pauline, was born December 11 in New York City, where his wife, Deb, was working. Russell received a call at his office in Philadelphia and made it to the Holland Tunnel as "Lena" made it into the world. . . . **Darryl Fraser** and his wife, Leslye (Miller, '78), celebrated their tenth wedding anniversary in June by taking a Caribbean cruise with a number of MIT friends including Nola (Hylton) Watson '79, **Geoffrey Holman**, and **Michael Ross** and their spouses. Daryl and Leslye have two children, Brittney (4) and Michael (2). Darryl is director of communication for TRW Space and Technology Group.

Some short notes: **Brian Torone** and **Walt Seale** attended Larry Siegel's ('78) wedding in January. . . . **J. Mark Karlen** is now an assistant professor

of anesthesiology at the University of South Alabama in Mobile, and he says come visit him for Mardi Gras! . . . **Howard Brand** has a private practice in endocrinology in Port Jefferson-Smithtown, Long Island.

By the time you read this in October, you should all have exciting summer vacations to write about. I spent nine days in Maui while my husband, Alan, attended an IEEE conference. It was great! Send your news to: **Kim Zaugg**, secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org.

81

On behalf of all '81ers, I'd like to thank **Lynn Radlauer Lubell** for doing a fine job as class secretary over the past five years. I'll be doing my best to continue to keep you all informed of what's new and exciting with our classmates.

One different approach to class news has occurred to me. It's often difficult to find time to sit down and write, especially when requests for information are accompanied by requests for money (as they frequently seem to be). On the other hand, many people are glad to talk about what they've been doing if they're asked in a more personal manner, and might also feel more a part of the class. So, don't be too surprised if you hear from me at some point. Now for the news.

Tying the knot: **Stephen C. Levin** writes that he and Susan Schnitzer were married on February 17, 1991. Says Stephen: "I better behave as she's an FBI agent!" When he's not under surveillance, he's pushing ahead with his composite-material bicycle frame company.

From the academy: **Jose Schutt-Aine** is currently an assistant professor in the Department of Electrical and Computer Engineering at the University of Illinois.

Proud daddy: **Chun-Chee Lau** reports the birth of his and wife Ingrid's second child, Jonathan, on April 25, 1991, to join 2-year-old sister Katharine. All are doing fine, although Chun-Chee "needs some sleep."

Captains of industry: **Bob Davies** presently is manager of planning and analysis at the Cooper-Tools division of Cooper Industries in Raleigh, N.C., where he's also enjoying the single life. . . . **Victor Miller** continues to work as a systems engineer for Loral Electronics in Yonkers, N.Y. . . . **Jeffery C. Tung** informs us that he finished an MBA at Harvard in 1986, then spent three years as an associate partner with KBA Partners of Fort Lee, N.J., a high-tech venture capital firm. In 1989, he joined Xerox Technology Ventures as a vice-president and principal. Jeffery also notes that he is "thoroughly enjoying the southern California living." Rightly so, I'd say. . . . Heading north, **Janine** and **Mike Nell** are living in the San Francisco Bay area, having left the Boston area after Janine finished a PhD in metallurgy at the Institute over two years ago. Janine is a senior engineer in the executive offices of Failure Analysis Associates in Menlo Park, while Mike is director of marketing at Zoran, a semiconductor firm in Santa Clara.

Telegenic/photogenic: **Rob Schoenberger** just celebrated the second anniversary of his company, Subtechnique, Inc., which does engineering in the fields of tele-presence and video. Rob is living in Old Town Alexandria, Va., and invites all classmates to stop by and visit. . . . **Ray J. Bulston III** is back in Newark, Del., with Hercules, Inc., after having done a tour of duty at the Hercules plant in Hattiesburg, Miss., for several years. In his spare time, "Ray J" is a highly accomplished photographer. . . . Oh yes, both Rob and Ray road-tripped up to the 10-year reunion (along with yours truly), where, among other enjoyable activities, we engaged in some truly serious campus archaeology, i.e., tunnel touring. Now that the history of hacking at MIT has been written, somebody's going to have to put together a guide to the tombs and tunnels.

To conclude this month's update: I've moved to

a new location, also in Old Town Alexandria. Thanks to all you writers, and I hope to be hearing lots of news from you in the months to come. I've also been informed that *reunion photographs* can be included in the class notes, if space permits. So send in your best photos, with appropriate caption information.—**Mike Gerardi**, secretary, 1250 S. Washington St., #807, Alexandria, VA 22314, (703) 548-8409

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Please send news for this column to: **Stephanie Pollack**, secretary, 25 Royce Rd., Newton, MA 02159

83

This is the year that many of us are turning 30, and **Chris Schneider** and **Ken Krugler** decided to celebrate in style. Their 1st Tri-Decennial High Altitude Birthday Party in the Sky (aka five days camping in Kings Canyon National Park) was a tremendous success. The trip combined hikers of three different skill levels (psychotic, healthy, and genteel) with all groups meeting together for the final night birthday party at 11,300 feet. Our class was well represented by **Chris**, **Ken**, **Mike Santullo**, **Alan Taylor**, **Jeff Muss**, and me. Other MIT alumni included **Jim Allard**, '84; **Brian McKeller**, '84; **Mike Brombert**, '70; **Bob Vokes**, '87; **Todd Bayer**, '84; **Scott (Jack) Davis**, '82; and **Rob Freeman**, '84.

The main hiking event featured the scaling of 13,800-foot Mt. Agassiz. Since the mountain was still covered in snow, the "ride" down was a lot easier than the climb up. The psychotic group then went off to do some technical climbing, but no details will be provided so that the guilty will still be able to obtain life insurance.

Jeff Muss and **Marilyn Bryant** recently announced their engagement. They met in Florida when Jeff was earning a master's at the University of Miami, and have been living in California for the past several years. A mid-October wedding is planned. The unexpected will be expected. . . . My sources in Boston also tell me that **Anita Flynn** is engaged to an MIT '83 classmate, but no details have been provided yet.

Harry Newman is living in NYC and is a playwright. He just got married to Ninotchka Rosca whose book *State of War* was just published by Simon and Schuster. . . . **Dawna Levenson** was last spotted in Raleigh, N.C., working with Arthur Anderson.

The following people jotted down what they were doing while giving money to MIT: **Stephen Johnson** says that he worked in Silicon Valley for a short time but found life there most distasteful. He is now in Colorado Springs working for NCR/AT&T. . . . **Erik Hjerpe** writes that he is pursuing a master's degree in mechanical engineering at the University of Massachusetts at Amherst. . . . **Craig Russell** is working toward a master's at RPI, and will teach at West Point in the summer of '92. . . . **James Roberts** writes that he recently received a professional engineer's license in Washington State. . . . **Ken Segal** writes from Houston about his new son, Zachary Alan, born last December. . . . **Norman Fortenberry**, apparently not a fan of prose, sent an outlined list of accomplishments. They are 1) assistant professor of mechanical engineering and FAMU/FSU College of Engineering in Tallahassee, 2) associate director of Minority Engineering Programs, 3) teaching mechanical vibrations, intro. to design, and senior design projects, 4) busily pursuing funding (ed. note: double credit for use of an adverb!), and 5) starting a version of UROP for engineering students. . . . **David Chan** writes that he is a senior engineer at Cadence Design Systems (a TA Associates portfolio company) in Andover, Mass. Please write.—**Jonathan Goldstein**, secretary, TA Associates, 45 Milk St., Boston, MA 02109

Ken Zeger was awarded an NSF Presidential Young Investigator award. . . . **Deborah Summa** is finishing a PhD in mechanical engineering, specializing in acoustics and hoping to move into the biomedical field. She is also having a good time scuba diving with members of her research group.

Our apologies go out to **Tom Drenner** who has given generously for the last four years and has yet to see his update in print. Let me assure everyone that we print all the mail we receive (and only wish we received more). Getting our act together: Tom has a son, Zachary Thomas, and is continuing work on a PhD at Cornell in resource economics. His wife, Laurel Dallmeyer, has her own medical practice, which keeps them very busy in their few spare moments.

Capt. **David Martin** is working as a flight test engineer on the AWACS program for the Air Force at Boeing. He was married a year ago to Elizabeth Crawford John, an alumna of the University of Lowell. He is almost finished with an MS in systems management at the University of Denver. . . . **Elaine Lee** is back at MIT working on a PhD in the HST program. She left a position at Boston Scientific Corp. in Watertown where she was working on developing new balloon catheters for angioplasty. Elaine can again be found dancing with the MIT Ballroom Dance Club.

James Kelley was spared from a trip to the Mideast and is in Phoenix at Luke AFB as an F-16 instructor pilot. . . . **Steven Leibiger** has a new job at Silicon Systems in Tustin, Calif. He was married in July to Tina Ciasca. . . . **Hendrikus Meerman** is still pursuing a PhD in chemical engineering at the University of Texas. He was married in January to the former Jodi Bosnell. Some MIT alums who attended the wedding were: Mike Delaun, '82; Susan Feinot, '82; Bill Tsacoyeanes, '83; **Ian Hueton**; **T. Colin Mack**, Mat Womack, '82; Lt. Pete Ulrich, '86; John Martin, '86; Dave Pehlke, '86; Doug Frieberg, '86; and Dr. Rob Saso, '86. . . . **Eric Burger** is back in the U.S.A. He is consulting for MCI on advanced computer platforms and the use of supercomputers in high-volume transaction processing. . . . **Luis Torres** graduated from the University of California/Davis medical school in 1988. He finished his internship in June 1989. He has been serving as a Brigade surgeon for the 193rd Infantry in Panama since the summer of 1989. . . . **Adrian Yovanovich** is living in Boston and working as a management consultant for the MAC group.

Daniel Bullock has become a Christian, gotten married, bought a house, and started work on a master's degree at the Air Force Institute of Technology (with commensurate better grades) since graduating from MIT (i.e., not all in the last week). He is a captain at WPAFB and expects to be at Hill AFB in Utah come 1992. . . . **Victor Agüero** is doing doctoral research on tethered satellite systems, a joint NASA-Italian Space Agency shuttle mission. Victor has worked with a lot of MIT grads and currently faculty and students on this project. Launch will hopefully come sometime in '92 (with enough all-nighters).

Bruce Kinsinger completed medical school in 1989, spent a year in fellowship in medical decision-making and is presently finishing an internship in family practice in Baltimore. . . . **Steve McDonald** is still working for MIT's EAPS. His wife graduated in June and both of them may begin graduate school soon and/or start a family. Steve recently joined SCA and has taken up archery with the MIT archery club.—**Howard Rubenstein**, secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), hbr@mitre.org.

Uh-oh, your usually diligent class secretary misplaced an envelope containing news submitted by

people contributing to the Alumni Fund. So, if you sent information along with your check around May or June, please drop me a line so that your news will appear in the *Review*. Many apologies for this screw up.

Back to the real news. **Steve Bradley** recently passed his oral qualifying exams in mechanical engineering at Berkeley. Steve has more than that to be happy about. He will be attending the University of Kaiserslautern for one year as a Fulbright Scholar studying engineering design and practice in Germany.

The emphasis will be on studying design methodologies that promote teamwork and their support with computer tools. Since Kaiserslautern is in Bavaria, Steve will also have many opportunities to study German beer consumption. Steve would also like to hear about some of his DU brothers here in the class notes.

Captain **Inge Gede** recently hit this class officer up for money. It cost \$35 to find out that she will be attending Columbia University this fall. Also, she still loves the Air Force, and still loves being married to her husband, Captain Wayne "Apple" Applewhite. (They still hold hands! Just what is in that Texas water?)

Ruth Fricker is working at Advanced Cardiovascular Systems in Santa Clara, Calif. As fit as ever, her recent activities include scuba diving and underwater photography with her new camera. After graduating from traffic school this summer, she plans to fly—not drive—to Alaska. Canada is saved.

Bill Messner. He's tan. He's skinny. And he's ready to report your news. Write or send campaign contributions to 520 Key Blvd., Richmond, CA 94805, (415) 237-3795, inter net:messner%cmld6@ucbarpa.berkeley.edu

86

A hearty thank you to all who attended (about 80 plus spouses and guests) the reunion! A good time was had by all. As is obvious by now, I was reinstated as secretary. The rest of your class officers are: **Mary Ystuetta**, president; **Kim Hunter**, vice-president; **Lisa Mitchell**, treasurer; **Sharon Israel**, class agent, and a new office: **Mark Wolf**, social chairman.

Richard Jahiel married Karyn Baum, '90, on August 19, 1990, at Ann Arbor, Mich. Other '86ers there were **Morgan Liu** and **Peter Garfield**. Richard got his master of education from Harvard, and Karyn's been doing research in genetics at Michigan General Hospital. They'll both be entering med-school at the University of Michigan next year. . . . On January 12, 1991, **Anne Reeves** married **Tim Saarinen**, and they currently live in Palo Alto, Calif. Tim works for Varian, and Anne is in the interview process after leaving a consulting firm in Bridgewater, Va.

Susan Visser is at the University of Wisconsin. . . . Keith and **Ellen Dixon Law** will be married five years this August. They live in Triangle, Va., since Ellen works for the Justice Department in D.C. Keith still works for a Boston company. Some commute!

Kim Hunter (our new vice-president) has started her own company. BKT Enterprises, Inc., opened its third retail store in New Hampshire last summer (Hunters' Yarn and Needlework). Kim is president of the corporation, and they also have a manufacturing/wholesale company called Merrill's of New England. Kim is also on the Associate Board of Directors of the National Needlework Association, where she's having a super time (the travel to southern California, New York and Chicago once a year isn't bad). She also will have her first original sweater design shown at a national show this January. Kim says, "It's a far cry from chemical engineering but a lot more fun."

Doug Smith and Colleen ('87), his wife, moved to beautiful St. Simons Island, Ga., where they're enjoying the sun, sand, and surf. Doug is a process engineer with Hercules. Colleen is a

physics teacher at a local high school. . . . **Diane "Quick" Apgar** married John Apgar, '87, and is living in San Jose, Calif., with their daughter, Jordan, and son, Taylor. Diane works as a research scientist at Integrated Systems, Inc., in Santa Clara. . . . **Suzanne Summer**, MD, is starting her residency in emergency medicine at Highland Hospital in Oakland, Calif., in June. She has two kids—Eric, 3 months, and Theo, 3 years. . . . **Hubert Delany** founded Delany Enterprises, Inc., the first third-party software vendor for the Connection Machine parallel supercomputer. Their product, Crystal, is a real-time visualization package with the world's fastest volumetric rendering. Recent work has appeared in *Scientific American* (photo, page 107, January 1991 issue) and the *New York Times* (photo in "Science Times" section, January 1, 1991 issue).

Susane Havelka married Vladimir Dackiw, '85, and they reside in New York City. Susane got her master's in architecture from Columbia University in 1989 and has worked in Osaka, Toronto, and now in New York City as an architect. . . . **Jim Russell** finished a PhD last May (1990) in computer science at Cornell. In June, he married Susan Blodgett. In July, they bought a house in Stamford, Conn., where he started working for IBM Research in Hawthorne, N.Y. Jim says that adjusting to life as married homeowners really makes one appreciate student life. . . . **Mike Liebson** has been brushing up on his French in Paris since he's getting an MBA at INSEAD in Fontainebleau, France. . . . **James Berrettini** decided to take a break from music (the Motherfckers and Victory Pigs), Boston (where these bands were based), his job at Digital, and his alter ego Penn Jacobs to work for Salomon Technology Services, Inc., and live in New York City, where he's writing stories. In the fall, James plans to attend St. Johns College in Annapolis for an MA in liberal studies.

Susan Wittman is an MIT Lincoln Lab staff member. . . . **Jim Butler** just started his third quarter at the University of Chicago studying for an MBA. This summer, he worked for Hewlett-Packard in Corvallis, Oreg., as a financial analyst. . . . **Ellen Epstein** graduated from Wharton in June and spent several weeks in Lithuania teaching capitalism to budding democrats. When she returns, she'll be working at Morgan Stanley (I think) in New York City, where I hear she has a cool apartment with a deck. . . . **Anne Fricker** has turned a new leaf on life and quit her job at Clorox to move to England, where she'll spend the summer trying out all the taverns. In the fall, she plans to return to the States and take up residence in Boston where, we assume, she'll have to, alas, work again. . . . As for me, I spent ten glorious days in Hawaii doing a lot of diving. It was so nice, Erik and I almost bought a dive boat business and stayed! Thanks for all the letters. It was good to see everyone again.—**Mary C. Engbreth**, secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (213) 376-8094

87

5th Reunion

The saga of the MIT Class of '87 continues: **Bradley Feld** is living in Boston and is president of a ten-person software consulting company named Feld Technologies. The company writes custom software for a variety of companies (medium and large) and provides information technology consulting services to large companies. . . . **Dana Takaki Denning** is living in Menlo Park, Calif., and has just purchased a new old house. Dana was recently promoted to manager of the mechanical engineering group of the Automated Test Systems Division of KLA Instruments. Congratulations! . . . **Charyl L'arrivee-Elkins** wrote from Cranbury, N.J., and will be working for American Cyanamid. She finished a degree at the University of Wisconsin at Madison and is looking forward to being on the East Coast again. Cheryl will be attending **Stephen Pasternak's** wedding in Canada with **Rovena Sobarzo**, Hoi

Man Siu, and Jean H. Lee.

Kimberly Chasteen graduated from the Marshall-Wythe Law School at the College of William and Mary in May 1990. She is now working in the Office of Patent Counsel at the NASA Langley Research Center in Hampton, Va., as a patent attorney. Kim is engaged to be married this November to S. Douglas Bowmer. She met Doug in law school. . . . **Doug Smith and Coleen Smith** moved to beautiful St. Simons Island, Ga., and are enjoying the sun, sand, and surf. Doug is a process engineer with Hercules. Coleen is a physics teacher at a local high school.

Congratulations to **Dave Iacoviello** ("Commuter Dave") on his recent marriage to Phyllis DeCrescendo. **Jay Cohan** was at their wedding and said he had a great time! Jay Cohan just moved to the Big Apple and is working for Syntra. It may be smaller than Oracle, but he gets to drive to New Jersey every day. Also at the wedding were **Chris Adams**, '88, and **Liz Carducci**. Chris is working in Dallas for Texas Instruments.

. . . **Jim Lin** wrote to me from Cleveland Heights, Ohio. He just got back from a trip to Acapulco with **Stan Oda**, **Dave Maes**, **Dave Jesurum**, and **Krishna Komanduri**. They had a great time! Krishna and Jim are graduating from medical school, University of Minnesota and University of Chicago, respectively. Jim will be starting his internal medicine residency at Case Western Reserve University in Cleveland and Krishna will be in internal medicine at UCLA. Others graduating from medical school include **Rachel Chin** going into emergency medicine at Stanford and **Dave Napoli** and **Walter Rho** both going into orthopedics at Columbia. . . . **Jim Keonig** is back up north (New York City) after three years in Florida. He is working as an attorney in the FAO Schwarz building (what would you expect?) for the law firm Weil Gotshal & Manges. Jim spent the last nine months working on the merger between NCR and AT&T. I wonder if 6.001 made the difference?

Finally, a plug for the New York Young Alumni Group: We're growing like you wouldn't believe with the Thank Elvis It's Thursday Club, the Career Development Workshops, outings, and much more! Call the NYC MIT Alumni Club for details at (212) 983-9100.

Now, I beg. . . please, please call or write to me and tell me anything you want as long as it has nothing to do with taxis!—**Stephanie Levin**, secretary, 393 West End Ave., Apt. 8B, New York, NY 10024, (212) 595-3172

88

Greetings everyone! I recently got together with **Chris Saito**, who is just back from the Persian Gulf. He was flying AE6's and had plenty of great stories to tell about how he was getting shot at, etc. He was in the New York area visiting his family and attended a wedding in Boston of one of the AEPI brothers. He was able to meet up with **Mike Couris** in Beantown. Mike spent a few months in San Diego (I think at San Diego Naval Hospital?) during the summer. . . . I also ran into **Brenda Chin** on the Upper East Side. She is working for McKinsey and is living with **Lily Huang**, who is working for Booz-Allen and Hamilton Inc. **Lily and Peggy Chang** spent a short vacation in Barbados in March. Peggy is working for Disney in California.

John Kohl is working for DEC in the Boston area. The company is paying for him to get a master's in computer science, so he will be starting at Berkeley in the fall of 1991. . . . **Ken Raeburn**, **Mark Eichin**, and some others formed a computer-consulting partnership and are doing various projects in and around Boston. . . . **Larry Labell** works for US DOT in Kendall Square and remains active in Alpha Phi Omega. He's the current section 95 chair, responsible for keeping track of all the chapters in New England.

Michael Izatt got an MS in chemical physics from the University of Chicago and relocated to

Tokyo in March 1990. He plans on being there for a long time. He married Kirsten Lundgaard (Smith, '89). He works at the University of Nevada/Reno International Division in Japan as a mathematics and physics lecturer and is co-owner (with a Japanese friend) of a consulting company that is growing very fast. They do two things: 1) install hardware and software, and 2) design vocational training programs and institutional math and science programs for major Japanese corporations, governmental entities, and private businesses. Very impressive! Good luck with it!

Gary Waldman and his wife, **Laura Grunbaum**, have been living in San Diego for the past two years. Gary is working at Auxiliary Power International Corp. as a marketing engineer. The company manufactures and markets auxiliary power for commercial aircraft. Laura is staying busy with medical school and has decided to go into pediatrics. She will be doing a rotation in Boston in the fall of 1991 and hopes to meet up with some old school friends at that time.

A bunch of MIT '88ers were out for the San Diego Crew Classic in late April. They included **Alan Sbarra**, **Adam Schwartz**, **Jim Pierce**, and **Brian Barth** ('87). **Jim Pierce** rowed in the race with the National Lightweight Training Center out of Boston. He is attempting to make the national rowing team for the third year in a row (good luck). Their boat came in second, losing to a Canadian national boat. Jim is a software project manager at MSI in Cambridge. Alan is working as a financial analyst at United Airlines in Chicago. Rumor has it he is dating a French foreign-exchange student, who he claims is "just a friend." Adam is well on his way toward earning a PhD in electrical engineering. According to Gary, "Everyone is enjoying life!" Good to hear it!

The same group (minus JEP, who was rowing at the world championships in Tasmania) spent a few days in Hawaii last November. Apparently one of the highlights of the trip was when, and I quote, "Adam got his 'technology reviewed'" (am I allowed to print this stuff?) You'll all have to ask him about it—I know my curiosity has been aroused!

Arlene Lanciani Marge married Charles Marge ('84) in the spring of 1991. They had been going out since he auditioned her for the MIT Concert Band during IAP of January '85! How romantic! They were married at St. Mary's Eastern Orthodox Church in Central Square in Cambridge. For their honeymoon, they spent a month in Greece. Charlie works at Arthur D. Little as a logistics consultant. Arlene is working on a PhD at MIT in architecture. She will be researching interior air flows and carbon-dioxide levels inside buildings while working toward conserving energy. They live in Davis Square and both still play in the concert band. . . . **Marcia France** helped out a lot at the wedding. Marcia received a master's in chemistry from Yale and is now working on a PhD at Caltech. She left Yale because she didn't like New Haven, and the department was small and didn't really have facilities for the type of chemistry she likes.

Other MITers in attendance at the wedding included **Amit Lath**, **Karen Dryer**, **Regina Valluzzi**, **Chris Towse**, and **Michelle Sarin**. Amit is working on his PhD in physics from MIT, but is doing most of his work at SLACK at Stanford (linear accelerator lab). Karen and Regina are both considering going back to grad school. Chris is working on a PhD in math at Brown. Michelle is in Boston after getting her master's in math from the University of Pennsylvania. . . . Thanks to all who wrote.—**Grace Ma**, secretary, 545 1st Ave., #7R, New York, NY 10016

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Well, 'tis the season for weddings and engagements, so here goes. . . . **Lisa Schwartz** and **Ron Carskadden** were married on Memorial Day weekend at Lisa's parents home in Hewitt Neck,

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Long Island. Lisa and Rob write: "Fortunately, our garden wedding was blessed with sun, breeze, and 75-degree weather. After a fairly brief ceremony, the reception included good food, good drink, excellent music, and great friends. Lasting for almost six hours, the reception was followed by another four hours of viciously competitive pool volleyball.

"The guest list for the wedding included numerous MIT alums. Lisa's bridesmaids were **Sonya Hwang**, who is working on a marketing project for Andersen Consulting software at Florham Park, N.J., and **Suzanne Driscoll**, who is working in a biology lab at Columbia University. Suzanne will be leaving New York in September to attend Stanford. Also among the guests at the wedding were: **Christine LeViness**, who is also at Andersen in Florham Park doing some work for AT&T; **Rich Lightburn**, who served as one of the groomsmen and is a trader of mortgage-backed securities at Goldman Sachs; **Mike Petro**, marketing manager of Video Ordinance, a military technology programming firm; **David and Lisa Costello**, proud owners of an ice cream store in Pittsburgh; **Bob Hunt**, supervisor at Mariner Astubco and engaged to be married to Susanna Young (Simmons '90) July 4th weekend; **Bob Rizika**, technical salesman at Teledyne in Dallas; **Steve Betz**, engineer at Skil in Chicago; **Brian Lasher**, who will be attending Columbia Business School in the fall; and **Keith Colmer**, computer programming wiz with the Air Force in Colorado. Other alums attending were Mike Schoen, '87, and his new wife Kathleen, Daniel Kennedy, '87, Lowell Kim, '87, Stephanie Levin, '87, Janet Zahradnick, '87, Maria Kozloski, '87, Jeff Kloor, '87, Ed Savard, '87, Lynn Schlactus, '87, and her fiancé Joe Folds, Steve Cooperman, '87, and his new wife Johanna, Steve Mackler, '87, Carla Kapikian, '88, Rob Pokelwald, '85, and Bill Coleman, '85, who served as a groomsman."

The next morning, Lisa and Rob traveled to Ocho Rios, Jamaica, for a week of fun and relaxation at the Sandals Dunns River resort.

"However, reality set in upon our return to New York, as Lisa returned to her duties as an actuarial analyst with Kwasha Lipton (benefits consulting firm) in Fort Lee, N.J., while I returned to my job as a financial analyst at Young & Rubicam Ventures. We currently live around the corner from the United Nations in Manhattan but will be moving to the quiet suburbs of northern New Jersey later this summer."

Suzanne Driscoll also passed along news of her engagement to Andy Plump, '87. They are planning to be married in September 1992. Suzanne will be starting at Stanford in a PhD program in the Developmental Biology Department in the fall. Suzanne recently presented some of her work in a poster paper at a conference in San Francisco. She also has been a Teen Club advisor for the past year, and one of her students from the club recently was accepted to MIT.

Daniel Canaday was recently married to Amy Bereton and is currently studying medicine at the University of Chicago. Among the guests at the wedding were **Colin Angle**, who is a graduate student in the MIT AI Lab, building mobile robots, **Olaf Bleck**, who is a staff member at the AI Lab, **Dean Fiala**, who was best man, **Pavlo Rudakevych**, and **John Apostolopoulos**, who is at MIT working on a PhD in electrical engineering. . . . **Marlene Lamas** was married to Mal Cullum, who is a biology professor at the University of Chicago, in June. . . . **Jeffrey Schwefler** is stationed in Germany and is living in a little village near the Rhine River. Jeffrey recently received a visit from some Next House friends.

Gary Curwin is finishing up his first year of law school at Harvard. He has a summer job in New Jersey. . . . **Jackie Berger** is starting school at Princeton in Economics. . . . **Ann Mailhot** is working on her master's in ceramic science and engineering at Rutgers, developing materials for fiber optics. She hopes to graduate in the fall. Her husband John, '88, is currently at AT&T Bell

Labs in Murray Hill, N.J., working in the architecture group of the AT&T high definition television system.

Bill Jarrold has been living for almost a year in Austin, Tex., working on MCC's CYC project, a 10-year artificial intelligence project the goal of which is to build a machine with "common sense." Bill should be appearing in a NOVA episode about AI in September (about the time you get this issue, so check out that TV guide!). Bill thinks Austin is a great town. . . . **Dorit Brenner** is entering his third year of graduate school in molecular and cell biology at UC/Berkeley. . . . **Wilberto Martinez** has been selected for a national fellowship from the Consortium for Graduate Study in Business. Wilberto, along with 250 corporate executives, will participate in an orientation program at the University of Texas before attending New York University in the fall.

Charles Whetsel writes, "Traveled from Pasadena, Calif., back to Boston for graduation and saw quite a few classmates. **Bill Mahoney** is still working for Rohm & Haas in the Philly area and just bought a condo (oh, to be among the landed gentry). . . . **Dean Ebesu** will be returning this fall from a year of working for Nissan in Japan. . . . **Chris Crowley** finished his MS in 6-1B and will be working for Hewlett Packard, Andover, in the fall. . . . **Brian Pan** is working on his MS part-time and hoping to move to Albany Street when he gets kicked out of Tang. . . . **Dave Atkins** is in law school in Washington, and still deeply involved in student government."

Charles continues that **Kurt Eberly** and **Claudia Ranniger** are finishing Course XVI master's degrees this summer. Kurt will be working for Orbital Sciences Corp. in the DC area this fall, while Claudia will start an MD/PhD program this fall at the University of Maryland, where **Joe Orso** is trying to finish his MS before the fall. . . . **Adam Dershowitz** is also finishing his MS and will be one of the first graduate TAs for Unifried next year. Adam's old roommate, **Pete Andrews**, and **Dee Hall** are sharing a place in suburban Rockport, Mass. Dee has forsaken her aero/astro training and is building interferometers for a small start-up R&D firm in Massachusetts.

Charles and **Alan Diccio** will both be returning from NASA JPL to school this fall at Stanford, both in the aero/astro MS program. . . . **Jim Reich** has decided that it would be a good time to get out of General Dynamics in San Diego, where he and **Matt Thompson** and **Kia Freeman** have been working. . . . **Mike Fincke** will be joining the LA area crowd when the Air Force moves him out to Edwards AFB later in June. Thanks for the news Charles!

Tomas Saulys is living in Malden, Mass., and is working at Raytheon in Tewksbury. Tomas finished an MS in CS at the University of Wisconsin in February. . . . **Patrick Goshgarian** and **Mark Olson** came to town during commencement weekend. Patrick is still working for an economic consulting firm, and Mark is still working for Baxter, although he is based in LA temporarily (he used to be out in Chicago). . . . **Mark Moss** vacationed in the San Francisco area after his tour of duty in South Korea. . . . **Venu Chivukula** just moved into a new apartment in LA. He is doing fine even though Northrop has had some setbacks lately.

Bill Maney led a hiking trip in Yosemite during Memorial Day weekend with **Ron Koo**, **Angeli Salgado**, **John Flight**, **Joe Lichy**, **Mike Turek**, '88, and **Laura Scolnick**, '90. Ron reports on their trip: "On the first day we were there, we couldn't find the crossing for a river because it was swollen from the melting snow. We finally had to cross on a log that the water was partially lapping over by the time we crossed in late afternoon. Although we started on the highest elevation on the trail, we only had to go through patches of snow. On the second day, some of us climbed up Half Dome, which has a peak at about 8,200 feet. The view was indescribable. I felt as if I had entered a small slice of heaven. On the third day, we hiked down into Yosemite

valley, which was packed with tourists. I think that I preferred hiking and camping in the high country where there were fewer people."

Ron, after learning the rudiments of mountain climbing at an indoor rock climbing gym near San Francisco, returned to Yosemite a few weeks later with his supervisor and **Bill Maney**. They climbed El Capitan on one of the gully routes covering 4,000 vertical feet in one day.

Tim Sulzbach is working for IBM, and is living in Brewster, N.Y. Tim has been keeping busy working, lifting, cycling, and playing softball on the company team, which is 7-1 and in first place at this writing. Tim has also been taking advantage of the proximity to New York City by journeying in and catching some Broadway shows.

Well, I'll have moved by the time this new issue comes out, so here is my new address: **Henry Houh**, '89, secretary, 4 Ames St., Cambridge, MA 02139. I don't know my new phone number, but my e-mail address is still good: tripleh@athena.mit.edu or, a new way of getting mail to the same address: henryhouh@mit.edu

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Jay Damask writes that he has finished his first year of graduate school in electrical engineering and computer science at MIT. He has spent the past year doing research in optics with Professor Haus and being a TA. Jay mentions that **Howard Weingram** is working in San Francisco at Oracle and **Stephanie Patterson** is in Ohio in ROTC. . . . **Cyndi Downey** writes from sunny Huntsville, Ala. She's working for Boeing on the ever-changing Space Station Freedom Program. Cyndi tells us **Tricia Wilson** is working on a master's degree in materials science at the University of Michigan. . . . **Eddie Hernandez** is working at Ford Motor Co. (also in Michigan). It seems that Eddie's been having a great time on the test track with the newest model Mustang!

Ed Hahn is a graduate student at MIT busily working in the aeronautical systems lab. . . . **Andy Nisbet**, **Mike Valdez**, and **John Ziegler** are sharing an apartment. . . . **Eva Clarke** is a lending program officer for the Boston Community Loan Fund in Jamaica Plain, Mass. . . . **Ken Berghenthal** writes from southern Thailand, where he's in the midst of a two-week vacation through Thailand, Malaysia, and Singapore. He says things are cheap over there (a one-hour massage for only \$6!) and the scenery is beautiful. . . . Congratulations to **Justyna Bodzich**! She is now married to **Vadim Teverovsky**, '89.

Speaking of weddings: a number of people from our class were at the May wedding of **Joseph Jones**, '89, and **Jennifer Hamel**. Present at the wedding were **Penny Plummer**, **Andrew Fusco**, **Irene Wang**, **Pete Rovelstad**, **Chris Bald**, **Mike Murray**, **Bonnie Scurlock**, **Mary Kay Smith**, **Matt Fox**, **Mike Sununu**, and **Pillan Thirumalaisamy**.

Zain Saidin and **Joanne Spetz** are living in Palo Alto. Zain started his new job at KLA Instruments in May, while Joanne studied for her June comprehensive exams. Both of them have seen a lot of **Micah Adler**, who is working at Oracle. Joanne also saw **Elenna Dugundji** in California. Elenna was passing through California while traveling to Mexico. She's already been in the Pacific Rim, Africa, India, Australia, and New Zealand. . . . **Mary O'Donnell** writes that she had a great spring break in the Washington, D.C., area with **Sujatha Varadarajan**, **Cindy Shen**, and **Ellen Case**. . . . **Lori Fretz** is working in Florida. . . . **Greg Gould** and **Karen Fu**, along with a group of others, were recently in California for vacation. They also spent some time at Lake Tahoe. Congratulations to **Karen Fu**, who was accepted to a chemical engineering program at MIT!

What did everyone do this past summer? Send me news about your vacations! Please note that I'm using a different address now, and that this address will change AGAIN when I move to my new place.—**Ning Peng**, secretary, 10140 Creekwood Circle, Plymouth, MI 48170, (212) 745-2704

Joel Moses, PhD '67, Dean of Engineering

Gerald Sussman, '68, professor of electrical engineering, calls him "a great guy who not only is smart, but knows how to organize things, who even—and this is rare—has a theory of organization."

Arthur Steinberg, associate professor of archaeology, with whom he wages a running computer-mail debate on philosophical issues, calls him "a technically trained academician who came only recently to a strong, deep interest in issues of culture and social complexity, and is all the more committed to them for that reason."

Since his appointment by Provost Mark S. Wrighton in mid-January, the MIT community has called Joel Moses dean of the School of Engineering.

The Dugald Caleb Jackson Professor of Computer Science and Engineering, holder of bachelor's and master's degrees from Columbia and a doctorate in math from MIT, Moses is best known for the development of MACSYMA, the largest existing computer system for algebraic formula manipulation. He also distinguished himself as head of the Department of Electrical Engineering and Computer Science from 1981 until 1989.

Expansive intellectually, spiritually, and physically, Moses has a commanding presence that seems to embody his leadership role. He frequently disarms listeners with an unexpected quote from his Old Testament namesake or a telling anecdote about the ancient lawgiver, whose image hangs on his office door in the Laboratory for Computer Science.

Moses got his first exposure to math and science in Israel, where he was born to parents who had fled Germany at the onset of World War II. The family immigrated to the United States in 1954, when Moses was 12. "It was hard for me, those first few months. I had been at the top of my class in Israel, but, because I didn't speak English, I was struggling in the



Brooklyn public schools. In math and science, though, I was two years ahead."

Moses expected to study medicine and designated math as his major at Columbia only "because it was so easy." Sailing through the undergraduate degree in just three years, he gained more confidence in math while absorbing humanistic insights in a series of Western Civilization courses that affected him more than he knew at the time.

"I didn't recognize the relevance of philosophy and related interests to real life until I was in my 40s. That's when I realized some of the issues I was dealing with as a computer scientist were broader than I originally thought," he says.

He became "really excited" during his last year of college about the idea of a computer program that could do integration problems in calculus. His interest was triggered by reading the thesis of James Slagle, PhD '61, who worked under the supervision of artificial intelligence (AI) pioneer Marvin Minsky at MIT.

So in 1963, Moses, too, embarked on a PhD under Minsky, producing a

dissertation that introduced the notion of a "knowledge-based system," a program that is an expert at what it does. His approach is now the accepted view in AI. Ultimately, a group led by Moses and Bill Martin, '60, developed that approach into MACSYMA.

An "Algebraic View of the World"

Just as he "fell into" mathematics and computer science as a career, Moses says he fell into teaching, accepting a position in the Electrical Engineering Department when he completed the degree. Sussman, who first encountered Moses "waving his arms around about computers" as a guest teacher when the former was a high school student in Brooklyn and the latter an undergrad at Columbia, says Moses' pedagogic strength lies in his ability to articulate his ideas one-on-one.

To Steven Lerman, '72, professor of civil engineering and chair of the search committee that recommended him as dean, Moses' ability to teach is intertwined with his ability to learn—that is, to listen effectively. It's an ability that provides a strong foundation for the new dean's administrative skills, which in Sussman's estimation are built upon Moses' "highly organized, algebraic view of the world."

In 1974, he became associate director of the Laboratory for Computer Science, and in 1981 was named department head in EECS when Gerald Wilson, '61, became dean of engineering. While many observers credit Moses with keeping MIT at the forefront of electrical engineering and computer science during the 1980s, Moses passes most of the credit to Wilson. "Gerry was a dynamo as department head. He started an enormous number of projects. My role was to carry them forward when he became dean."

Possibly the most critical issue dur-

ing Moses' tenure as department head was an outgrowth of the department's success. Accustomed to enrolling about a quarter of MIT's undergraduate majors, EECS discovered in spring 1984 that it was the choice of about 38 percent of incoming students.

"This 50 percent increase, albeit over a decade or so, was something we just couldn't handle. MIT was willing to let us hire more faculty, but we couldn't hire people fast enough, not of the quality we wanted. There was an Institute-wide campaign to talk people out of majoring in EECS. We didn't want to be seen as chasing people away, so we just counted on other faculty members to promote their own departments." That strategy worked, and the number began to bounce back and forth in the 20-30 percent range. Recently, Moses says, it has crept up to nearly one-third, and again needs to be "looked at."

Weathering the overpopularity crisis, however, is not the achievement that gives Moses the most satisfaction. "My proudest accomplishment," he says, "is an increase in faculty collegiality." Samuel Jay Keyser, MIT's associate provost for educational policy and programs, seconds that notion.

As Keyser tells the story, "When I was made associate provost, Joel came to me and said, 'Your very first order of business should be to get people talking.' He proposed that I host weekly dinners to which we would invite 20 faculty members chosen at random from across the disciplines, going through the whole faculty in a year."

Keyser viewed that goal as too ambitious, but the basic idea appealed to him. Suppose he invited larger groups—on, say, a monthly basis? "I took the idea to several friends, and, to a person, each said it wouldn't work. Joel said it would. I was willing to give it a try," says Keyser, who summoned 50 professors to the Grier Room in the EG&G Building. Only 20 turned up.

"At first we were discouraged," recalls Moses, "but then we noticed something: Almost everyone who came was trained in Europe; they were used to collegiality. Americans weren't. Jay decided to try it again, but to cast a wider net. The next time, he invited 100 people. Almost 40 showed."

The dinners have been taking place monthly for about five years now, and attendance averages around 50. Says Keyser, "They are very lively. It's amazing how well people communicate when they're turned loose without a formal classroom or meeting setting."

Rethinking Master's Degrees

Among Moses' tasks as EECS department head was the creation of an experimental master's program—a second professional degree—for MIT students and mid-career engineers who are more interested in working in industry than pursuing academic careers. He also initiated a "rethinking" of undergraduate engineering education toward the same goal of preparing better practitioners for industry.

Describing those efforts as "a mid-course correction," the new dean explains, "Before World War II, engineering was more of an art, a skill taught in part out of handbooks. What evolved out of the interactions of engineers and scientists during the war was something called engineering science, in which engineers are given a better grounding in science and mathematics. MIT led this revolution. It's one of the main reasons we are as strong as we are."

"But now some of the same people who led this revolution are looking at what's happening with international competition and saying, 'Hey, wait a minute. We went too far.' Engineers make things, they design, they manage. These are issues that the engineering science approach doesn't quite deal with well enough. We have

to rebalance the whole notion—we have, in some sense, to rediscover the soul of engineering."

Now he is presiding over the School of Engineering as it fine-tunes its master's offerings, which Moses describes as "essentially research-oriented, pre-doctoral programs," not as well suited to the needs of those students who plan to go right into industry. What's more, many departments find that there is not enough time in the current four-year bachelor's program to cover the technical issues specific to each engineering discipline in sufficient depth. So the master's is "increasingly viewed as a capstone to a bachelor's degree," Moses says, creating an issue that carries its own set of problems.

Questioned about the challenges and opportunities facing technology today, Moses recites a familiar litany: global change and related environmental and energy issues, the revolution in telecommunications, questions of biotechnology, public health quandaries, and metamorphoses afoot in construction techniques.

Unlike most observers, though, Moses has developed a coherent way of thinking about these issues. He sees them all as "large-scale systems"—a category that, he says, encompasses everything from technological systems (for example, the design of a car) to sociotechnical systems (such as the environment, with all the physical, political, ecological, economic, and humanistic considerations involved).

"If we could come to grips with the fundamentals of large-scale systems, we could gain a better understanding of all kinds of problems simultaneously," says Moses, who is co-chairing with Professor of Civil Engineering Daniel Roos, '61, a committee aimed at promoting research and education that focuses on such systems. ■

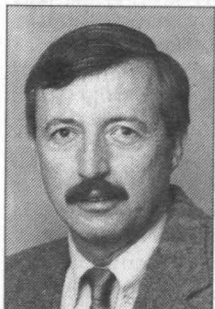
This article is based on a profile by Theresa Pease in MIT Spectrum, with the addition of some material from an interview in Tech Talk by Naomi Chase.

I CIVIL ENGINEERING

Dario Valencia-Restrepo, SM '72, CE '72, writes: "I have been president of the National University of Colombia since 1990. It is the most important university of the country, with almost 30,000 students distributed in four campuses: Bogota, Medellin, Manizales, and Palmira." ... **John C. McDugald**, SM '79, reports: "I retired from the U.S. Army in July 1990 and am presently teaching science at the Bullis School in Potomac, Md." ... **Scott D. Nason**, SM '77, sends word: "I was recently named VP for operations, planning, and performance for American Airlines at our headquarters in Dallas. My staff of approximately 700 people is responsible for the daily operation of the airline, including dispatch, crew scheduling, crew planning, operations engineering, and on-time dependability."

Robert J. Etter, SM '65, reports: "I have served since 1984 as chief engineer for the design and construction of the U.S. Navy's Large Cavitation Channel (LCC) test facility. A dedication ceremony for the \$100 million hydrodynamic and hydroacoustic facility was held last April at the David Taylor Research Center's Memphis, Tenn., detachment. Construction took more than three years and represented the largest U.S. Navy investment in an R&D facility since WWII. Participants in the dedication included numerous federal, state, and local officials including U.S. Senator Jim Sasser of Tennessee. An open house at the site was attended by more than 1000 people. Tests in the facility will assure quieter and more efficient surface ship and submarine designs."

Norb Delatte, SM '86, writes: "I am a captain in the U.S. Army stationed with the 92nd Engineer Battalion in Fort Stewart, Ga. I was deployed to Saudi Arabia from October 1990 through April 1991." ... **Eric Green**, SM '89, reports: "I have moved to Sugarland, Texas, and am working as an engineer for Failure Analysis Associates in Houston." ... **Karl Rocker, Jr.**, SM '68, a Naval



K. Rocker, Jr.

Civil Engineering Laboratory senior research engineer, was recently named the 1990 George W. Goethals Medal winner by the Society of American Military Engineers (SAME). The Goethals Medal was established in 1956 in honor of George W. Goethals, the military engineer builder of the Panama Canal. The medal is awarded annually to an engineer in civil or military practice for "the most eminent and notable contribution in the fields of engineering, particularly in design, construction, and methods." It was awarded to Rocker for "his expertise in seafloor geotechnology and application of this knowledge in the solution of problems of national importance to the U.S. Navy."

Olivia Maria (Libby) Reyes, SM '88, PhD '91, has been awarded a Eugene P. Wigner

Fellowship. Reyes is a research associate in the Environmental Sciences Division at Oak Ridge National Laboratory. The fellowship is named for the Nobel laureate and former director of ORNL and is awarded to outstanding postdoctoral-level engineers and life, physical, and social scientists. Reyes is encouraged to pursue independent research as well as contribute to ESD projects. ... **Erik Vanmarcke**, PhD '70, has been selected as the Shimizu Corporation Visiting Professor at Stanford University for Spring 1991. Vanmarcke, professor of civil engineering and operations research at Princeton University, was professor of civil engineering at MIT from 1970-1985. ... Course I Professor **Peter S. Eagleson**, ScD '56, was selected the 1991 winner of the Sterling B. Hendricks Award for the Agricultural Research Service, the principal scientific research agency in the U.S. Department of Agriculture. ... **Peter Likins**, SM '58, president of Lehigh University, has been awarded an honorary doctoral degree by Lehigh in recognition of his lifetime achievements.

II MECHANICAL ENGINEERING

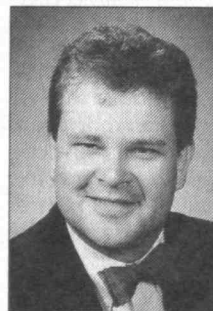
Anthony F. Varone, Jr., ScD '90, reports: "I am working as an engineer/consultant for Arthur D. Little, Inc., in Cambridge. I reside in Cumberland, R.I., with my wife Diane and daughter Jessica, who was born January 18, 1991." ... **Joseph K. Ting**, SM '74, sends word from Belmar, N.Y.: "I was elected president of ASHRAE (The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.) Northeastern New York Chapter on April 15, 1991 at the Century House in Latham, N.Y. My term of office commenced on July 1, 1991 and will run until June 30, 1992. I have been active with this chapter since 1986 and have been a member of ASHRAE since 1979. At the chapter level, I have served as president-elect (1990-91), VP (1989-90), treasurer (1988-89), chair of the research promotion committee (1987-88), and board of governors (1986-87). At the society level, I am serving as vice-chair of ASHRAE refrigeration committee (1990-92), and am a voting member of several committees." ... **Paul F. Swenson**, SM '63,



P.F. Swenson

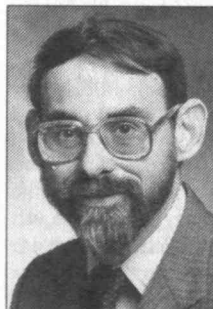
director of R&D at the Consolidated Natural Gas Companies in Pittsburgh, Pa., has been named a Fellow of ASME. His citation reads, "Swenson has been active in the development of natural-gas-fueled equipment for 25 years. He has pioneered the development of modern, low-cost, high-efficiency, high-reliability equipment by bringing together equipment manufacturers, HVAC engineers, and R&D sponsors. During his career in the gas industry, he has also led the development of other gas equipment such as natural gas engines, cogeneration equipment, and innovative interior gas piping."

On April 8, 1991, the University of Alabama named its 1933 graduate, **Sidney Whitt**, SM '37, "Distinguished Engineering Fellow of the College of Engineering," as well as a 1990-91 "Outstanding Mechanical Engineering Fellow." Whitt, a registered engineer in Montana and New York, is professor emeritus at the SUNY College of Environmental Science and Forestry associated with Syracuse University. He credits among others, Course II Professors C.W. Berry and James Holt, '19, for giving him a fine start and Course X Professors W.H. McAdams, '17, and H.C. Hattell, who rounded out his thermo and heat transfer background. "One hopes," Whitt writes, "they knew way back that they gave many of us a *running start*—that for me more than compensated the somewhat 'Bohemian student attitude' that I carried over from my early years in a Russian gymnasium." Whitt now resides in Bozeman, Mont. ... MIT President **Charles M. Vest** has been elected to the American Academy of Arts and Sciences. He was acknowledged for his "pioneering research on the use of laser and holographic techniques to make interferometric measurements in fluids." ... **R. Davis Webb, Jr.**, SM '81, PhD '87, has been named development specialist at Timken Research in the Timken Co.'s Technology Center in Canton, Ohio. Webb joined the company in 1982 as a process engineer. Most recently he served as principal development engineer. ... **Michael Ming Chen**, SM '57, PhD '60, professor of mechanical engineering at the



R.D. Webb, Jr.

University of Illinois at Urbana, has been elected a Fellow of ASME. According to a citation in *ASME News*, "Chen has made significant contributions to a broad range of subjects, which include condensation, bio-heat transfer, thermal instability of boundary layer flows, heat transfer in low Prandtl number fluids, and more recently, the hydrodynamics of fluidized beds. He has also been instrumental in bringing attention to the important role that heat transfer plays in manufacturing and materials processing." ... From Sunnyvale, Calif., **Michael Hollars**, SM '80, reports that he has recently joined the startup company Rasna Corp., which is developing a family of advanced MCAE tools. ... **William T. "Tilt" Thompkins**, SM '73, PhD '76, has been appointed assistant director of research for Information Systems & Technology at United Technologies Research Center in East Hartford, Conn. He is responsible for overseeing the center's efforts in advanced technical computing, scientific visualization software development, artificial intelligence, digital system architec-



W.T. Thompkins

David Wilson Pushes Human Power

When David Wilson was hired by MIT in 1966, he was told by the head of the Mechanical Engineering Department that he would not be working in his field of expertise, heat transfer and fluid mechanics. Had he been allowed to pursue his true specialty, gas turbines, the world might have been a duller place. No one, in all likelihood, would have invented the pedal-driven lawnmower, the human-powered snowplow, and the "moving hand-rail"—a still-theoretical concept for shuttling cyclists and skateboarders up the hills of San Francisco.

The British-born Wilson, who is now regarded as the quintessential transportation buff, became one out of necessity. He was asked to conduct transportation research when he joined the MIT faculty. It was the kind of offer he could not refuse.

Wilson began by considering alternative methods for moving people around. In 1966, he developed the PAT (palletized automated transportation) system, which could increase the carrying capacity of roads by a factor of five to ten. The basic idea is that cars or trucks entering highways could drive onto flat platforms, or pallets, which would whisk traffic along at high speeds. Congested bottlenecks, such as Boston's Callahan Tunnel, might be the ideal place to introduce such a system.

Wilson hit upon the idea while hiking up Mount Washington. He saw the old-fashioned cog railway that scales New England's tallest peak and thought: "Here's a system that works in the most vile weather on the most extraordinary terrain. With modern controls and less severe conditions, we can do much better." Thus was born PAT—an automated highway that uses the principles of a cog railway. Although U.S. interest has died down, the Japanese government is still intrigued by the concept.

Wilson is perhaps most famous for the recumbent bicycle—a sort of lawnchair-on-wheels he developed in the early 1970s. About 20 companies now manufacture this style of bike. Recumbents are faster and more efficient than normal bicycles. In the early 1980s, a model he designed set speed records of 52 and 55 miles per hour. The current record for recumbents is 65



miles per hour.

Wilson rides his recumbent bike to work every day, eight miles each way, "unless the snow is very deep. Then I switch to a 10-speed," he says. MIT's Mechanical Engineering Department once held a retreat in Maine. Wilson pedaled up there to surprise people. He also rode to Pinkham Notch, N.H., 157 miles to the north, in a single day. Peregrinations like this have kept the 63-year-old engineer in fantastic shape.

Wilson and his students designed a new kind of bike braking system that provides better control in wet weather than conventional models. He also came up with the design for modern bike locks, similar to that later adopted by Kryptonite, Citadel, and other companies. He made no attempt to profit from the idea, figuring that one less stolen bike in the world is profit enough.

Wilson's obsession with bicycles might seem, well, obsessive. But he considers them the most practical vehicles around. "How is it acceptable for people to wait 10 to 40 minutes at a bus stop in a wind chill factor of 60 below zero, when it is not acceptable to ride a bicycle?" he asks. "My motor starts every morning without any digging for the key, and so does my heater. In a minute, I'm generating a kilowatt of

energy."

Bikes make sense, Wilson says, because half of all urban trips are three miles or less. Moreover, 95 percent of the people who make these trips are able to ride a bike. Recumbents are safer and more comfortable than standard two-wheelers, he maintains. Improved leverage makes it easier for just about anyone to ride 20 miles per hour, faster than traffic in many cities.

Wilson's industriousness is not limited to bikes, however. In 1972, while heading an MIT program in solid-waste management, he and colleagues developed and patented a trash-sorting system for recycling ventures. During his tenure as the local chair of VITA (Volunteers in Technical Assistance), he fashioned low-tech devices for Third World countries—windmills, solar cookers, and human-powered pumps that used ordinary bicycles to propel great volumes of water. With a student, he designed a muscle-powered hydrofoil, the precursor to a craft which recently raced across a Seattle lake at speeds of 17.45 miles per hour. He and another student, Michael Shakespear, '73, built a pedal-driven lawnmower that was used on the grounds of the Boston Museum of Science. As a result of TV publicity, companies started making these noise-free grass-cutters. Then there was the human-powered snowplow he assembled for his home—a special system of levers that allows a person to use his or her feet to clear the driveway, without putting a strain on the back.

If you throw in Wilson's stints in politics—he served on the staff of the Massachusetts Bay Transit Authority and was founder and president of MASH (Massachusetts Action on Smoking and Health)—and publishing (he edits the journal *Human Power*), the man has clearly poked around in a number of different fields. "I have been criticized for dabbling in different fields," he says. "But I was driven to this." An outpouring of imaginative concepts resulted—all because he wasn't permitted to work in his original specialty.—Steve Nadis □

The author is a contributing writer to Technology Review. He is also a bicycle fanatic and doesn't even own a car.

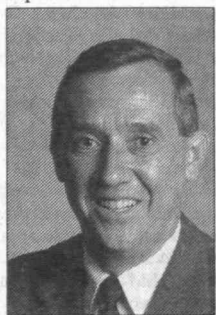
tures, computing networks, and data-base management. Prior to joining the Research Center, Thompson served as manager of the computer science laboratory at Northrop Research and Technology Center. He has also been an associate professor at MIT. . . . **George N. Hatsopoulos**, '49, SM '50, ME '54, ScD '56, has contributed a chapter entitled "Technology and the Cost of Equity Capital" to *Technology and Economics: A volume commemorating Ralph Landau's [ScD '41] service to the National Academy of Engineering* (National Academy Press, 1991). The chapters are papers that were presented at a Symposium on Technology and Economics in honor of Landau.

Prabha Sridharan, of Bedford, Mass., died of cancer on May 5, 1991 at the MIT Infirmary. Sridharan was a Course II assistant professor from Jan 1974 to June 1975. Her husband, Ramaswamy Sridharan is an associate group leader at Lincoln Laboratory. . . . Brigadier General **Alden Pugh Taber**, SM '48, of Pensacola, Fla., died in his sleep on November 12, 1990. There was no further information provided.

III MATERIALS SCIENCE AND ENGINEERING

Henry J. Nusbaum, PhD '77, sends word from Albany, N.Y.: "I received an MD from Albany Medical College last May and I started my residency in obstetrics & gynecology at Albany Medical Center Hospital last July. This may rank as one of the more unusual solutions to the famed mid-life crisis!" . . . **Pradeep Rohatgi**, SM '63, ScD '64, professor of materials at the University of Wisconsin at Milwaukee, has been named a recipient of the 1991 Graduate School/UWM Foundation Annual Research Award. According to a UWM news release, Rohatgi is an "international authority on metal-matrix ceramic composites, a field of great importance to Southeastern Wisconsin's manufacturing industries. In 1986, he established solidification and composite laboratories that have attracted substantial external funding from around the world. By developing new composite materials that are stronger and stiffer than monolithic metals alone, Rohatgi has done much to invigorate Wisconsin's foundry and engineering industries."

Cyril Stanley Smith, Institute Professor Emeritus and professor emeritus metallurgy and history of science and technology, has been given the prestigious Andrew Gemant Award for 1991 by the American Institute of Physics "for pioneering the use of solid state physics in the study of ancient art and artifacts to reconstruct their cultural, historical, and technological significance." The Gemant Award is given to individuals who have linked physics to the arts and humanities. It includes a \$5,000 honorarium and a contribution of \$3,000 to an institution of the recipient's choice for a graduate fellowship or lectures for the general public. . . . **William F. Schilling**, ScD '69, has



W.F. Schilling

been named president of Autoclave Engineers Group in Erie, Pa. Schilling will be responsible for all business operations of Autoclave, a producer of high pressure valves as well as reaction equipment and systems for the catalysis, chemical, petroleum, pharmaceutical, and polymer industries. Schilling joined Autoclave in 1989 after a long career with General Electric. . . . From Brookline, Mass., **Chris Kearney**, SM '83, writes: "This year I made my third visit to the National Autonomous University of Nicaragua, where we

have set up a laboratory to make solar cells for teaching purposes."

Richard W. Hertzberg, SM '61, the New Jersey Zinc Professor and chair of the department of materials science and engineering at Lehigh University, has been awarded the 1991 Teaching Excellence Award from the Lehigh College of Engineering and Applied Science. Student leaders from various professional organizations and honor societies within the college nominate and vote for the candidates. Hertzberg is the author of the textbook *Deformation and Fracture Mechanics of Engineering Materials*, now in its third edition. His research and teaching areas include fatigue and fracture of metals and plastics.

Captain Theodore Harrison White, SM '42, of Ardmore, Pa., died on April 28, 1991. White, a retired Navy officer, was a former engineering professor at Villanova University. He was nominated by his students for membership in the engineering honor societies Pi Tau Sigma and Tau Beta Pi. He retired from the Navy in 1960 and from Villanova in 1980. . . . **James Merritt Brownlow**, SM '48, of Norwich, Vt., died on April 11, 1991. After working at the MIT Laboratory for Insulation Research and for the Glenco Gulton Co., he joined IBM in 1953. Brownlow played a major role in ferrite core fabrication and became the chief technologist developing IBM's core manufacturing capability. He invented a firing process that allowed a six-fold yield for cores, and made improvements in composition and process that gave IBM a strong position in the core business. His contribution in the core areas earned him the status of an IBM Fellow in 1967. He anticipated critical technological needs with his work in processes and materials for mounting and interconnecting integrated semiconductor circuits. He led key developments for IBM's newest glass-ceramic products, just now entering the marketplace. During his 34 years with the company, he received numerous awards, and many patents were awarded for processes he developed. He and the people he brought into IBM were active in fields beyond ferrites, including analytical and solid-state chemistry, ceramics, and crystal growth.

IV ARCHITECTURE

Ed M. I. Hoosen, MAA '80, MCP '80, sends word from Ottawa, Canada: "My firm has been in operation since 1982, dealing with architectural, urban design, and planning projects in the national capital of Canada. I am chair of the Design Committee of Ottawa and I also chair various multi-cultural community groups. I always appreciate receiving *Technology Review*. Prior to '82, I was senior urban design planner with the city of Calgary."

William A. "Bill" Swiacki, Jr., SM '87, writes: "Effective August 1991, I joined the Los Angeles-based firm of PIA Sports Properties as VP. The company is a developer of planned communities, with particular emphasis on golf-course and resort communities." . . . **Joseph J. Scarpulla**, SM '83, reports that he is a professor of architecture at NYIT, a member of AIA, and a principal of JJS Architects.

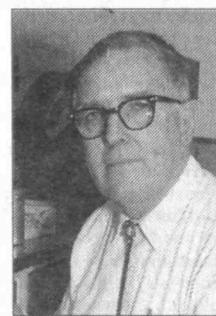
Bharat M. Gami, MAA '79, has been appointed to the Architects in Education committee for 1991 by the American Institute of Architects. The committee is charged with identifying unique needs and interests of architects employed in academic institutions. Gami is an architect-planner and an assistant professor of architecture at New Jersey Institute of Technology. According to an AIA release, "Gami believes that architects can apply their special skills as generalists in developing new and innovative solutions to the problems of affordable housing, environmentally conscious building systems, and a visually inspiring architecture. As an educator, an architectural consul-

tant, and a writer-photographer of a number of television documentaries, he has also been practicing what he believes in." . . . A 1991 Preservation League of New York State Award was presented to **Bernard Rothzeit**, BAR '51, MAR '54, of Rothzeit Kaiserman Thomson & Bee, for the restoration of City Center Theatre. Rothzeit was cited for "bringing theatre back to life with profound attention to detail and historical accuracy."

V CHEMISTRY

John W. Olver, PhD '61, has been elected to the U.S. Congress in a special election to fill the seat left vacant by the death of Silvio Conte. Conte was the lone Republican in the Massachusetts Congressional delegation. Olver, a Democrat, was a Massachusetts State Senator prior to this election. . . . **Martin Gall**, PhD '71, writes: "Since May 1990, I have worked as chemistry section manager for muscle relaxants and gastrointestinal research at Anaquest, Inc./BOC Health Care in Murray Hill, N.J. I also head an Anaquest task force set up to recommend new therapeutic approaches for treating ischemia." . . . **Louis D. Moore, Jr.**, PhD '51, reports: "I spent a year teaching English in China after my wife died on September 25, 1988. I married Betty Harmon last June." . . . **C. Reynold Verret**, PhD '82, sends word: "My wife and I have a new son, José-Emmanuel." . . . **Jim Beatty**, PhD '60, professor of chemistry at Ripon College, was selected as one of 10 participants for a National Science Foundation course on "Applications of LASERS in Chemistry" held this past June at James Madison University in Harrisonburg, Va. The intent of the program was to enable professors to bring home LASER experiments to enrich teaching at their colleges.

Chromatography/Mass Spectrometry Laboratory at ENSECO. According to an MWRA news release, "Chiu is nationally known for his analytical work with polycyclic aromatic hydrocarbons, a contaminant of major concern to the MWRA." . . . **Edwin P. Przybylowicz**, PhD '56, senior VP and director for research at Eastman Kodak Co., has been named to the U.S.-Polish Joint Commission for Cooperation in Science and Technology. The Joint Commission has the responsibility for policy oversight of the bilateral Science and Technology Agreement between the U.S. and Poland and for facilitating scientific and technological cooperation between the two nations. It is composed of eight members, four of whom are from the U.S.



K.R. Brower

Kay R. Brower, '48, professor of chemistry at New Mexico Tech, has been selected to receive the institute's Distinguished Research Award for 1991. Brower was selected for the award by a committee of Tech faculty members based on his "wide-ranging research in the field of chemistry." "Most recently, Brower's research has related to the safety of explosive and energetic materials—to defining the precise conditions under which a substance will or will not suddenly react. Many of the reactions that interest him happen in less than one-thousandth of a second. To study the details of such fast-moving events, Brower has devised techniques to measure temperature, pressure, and time of compression independently. Much of this research is done with very tiny quantities of explosives, less than 10 milligrams, which can be safely handled in the lab. His bigger experiments

on the capture and analysis of explosive gases are conducted at the Big Eagle test site of New Mexico Tech's Center for Explosives Technology Research," states a university news release. . . . **J. Stuart Fordyce**, PhD '59, has been named deputy



J.S. Fordyce

director of the NASA Lewis Research Center in Cleveland, Ohio. Fordyce has been director of Aerospace Technology at Lewis since 1984 and has had senior management responsibility for Lewis' efforts in aeropropulsion materials and structures research, space power, propulsion, communications, and advanced electronics technologies, energy technology, and microgravity materials science.

The Massachusetts Water Resources Authority has appointed **Kin S. Chiu**, PhD '83, as laboratory superintendent in the MWRA Sewerage Division. Chiu will oversee the design, equipping, staffing, and training of personnel for a new central wastewater laboratory to be completed on Deer Island in the fall of 1993. Prior to accepting this position with the MWRA, Chiu was co-founder and technical director of a start-up laboratory company called CEIMIC. He was also manager of R&D of the Gas. . . . **Paul E. Green, Jr.**, ScD '53,



P.E. Green, Jr.

manager of advanced optical networking at the IBM Corp.'s T.J. Watson Research Center in Yorktown Heights, N.Y., was selected to receive the 1991 Simon Ramo Medal from the IEEE. He was honored for "the introduction of modern system techniques to the interpretation of seismic waves, and the application of these techniques to distinguishing earthquakes from underground nuclear explosions." Green's work on seismic receiving systems provided a key improvement to the verification procedures already in place at the time of the Nuclear Test Ban Treaty of 1963.

Robert A. Laudise, PhD '56, director of the Materials Chemistry Research Lab at AT&T Bell Labs in Murray Hill, N.J., has been chosen a member of the National Academy of Sciences. . . .

Satoru Masamune, an internationally noted organic chemist, has been named the Arthur C. Cope Professor of Chemistry at MIT. The Cope Professorship was established in 1977 to honor the late Professor Cope, who served as head of the Department of Chemistry from 1945-65. Cope was internationally acclaimed for his distinguished research in organic chemistry and two processes in the field bear his name. Masamune's research interests include organic chemistry, organometallic chemistry, and enzymology. . . . **Alexander M. Klibanov**, Course V professor, has received the 1991 Marvin J. Johnson Award from the American Chemical Society. The prestigious award recognizes "outstanding and innovative research contributions in the area of biochemical and microbial technology."

MIT Professors **Robert J. Silbey** and **Jo Anne Stubbe** have been elected to the American Academy of Arts and Sciences. Silbey, the Class of 1942 Professor of Chemistry was recognized for his work with "electronic and optical properties of polymers and quantum dynamics of molecules," and Stubbe, the Ellen Swallow Richards Professor

of Chemistry and professor of biology, was cited for "molecular mechanisms of enzymatic reactions involving vitamin B12, and of drug-dependent processes that modify DNA."

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Nolan T. Jones, SM '54, reports: "I took early retirement from the Mitre Corp. last April. I just returned to New England in September after touring the Northwest and places in between. I did spotted owl habitat studies in the California Sierras in August." . . . **Arthur L. Fox**, SM '72, writes: "After cofounding three technology companies, Medical, Inc., Lexidata Corp., and Octek, Inc., I now serve as a mentor and close advisor to early-stage technology companies." . . . **Ronald L.**



R.L. Fante

Fante, SM '60, EE '61, has been named a Fellow at the Mitre Corp. and is one of the first two employees to hold this position at the Bedford, Mass.-based company. According to a Mitre news release, "The qualifications for Fellowship include a record of outstanding contributions to the company within a technical specialty and a broad, well-established reputation outside Mitre as a leader in the technical field of interest. Fante's specialty is adaptive signal processing, with significant applications to radar and communications. His expertise will be applied throughout the corporation, both as a contributor on specific projects and as a reviewer and evaluator of efforts within his technical specialty."

Rudy Cypser, ScD '53, sends word: "I completed another book on computer communications called *Communications for Cooperating Systems*. The book details the IBM approaches to data communications among heterogeneous computer systems that use different communication protocols. The evolving international standards, OSI, are shown integrated with the earlier SNA and TCP/IP protocols. The book, has 750 pages and 320 illustrations and is published by Addison Wesley in Reading, Mass." . . . **John W. Wood, Jr.**, SM '67, has been named chair at Thermedics, Inc., in Woburn, Mass. He had been the company's president and CEO. . . . **Bachman Information Systems, Inc.**, has promoted **John Cimral**, SM '83, EE '83, to the newly created position of senior VP. Cimral is responsible for the development of Bachman products. His areas of responsibility included product architecture, software development, quality assurance, documentation, and product management. . . . **Henry P. Hall**, '52, SM '52, senior staff scientist at GenRad in Concord, Mass., has been named the first Fellow within the company.



H.P. Hall

According to a GenRad news release, privileges accorded Hall, a 40-year GenRad employee, include "an 'in-service sabbatical' for a specified period of time to pursue research or assignments of the honoree's choice, staff designation as a resource to the company on broad technology issues, and the opportunity to select and serve as mentor to a candidate for the company's Masters in Industry Program. In addition, Hall will serve as an hon-

orary member of the company's patent/award committee and will be the recipient of an annual allocation to attend the technical seminar or conference of his choice." Hall has established a reputation as a technologist and innovator in impedance measurement. . . . **Mansour Shayegan**, '79, SM '81, EE '81, PhD '83, has been promoted to associate professor with tenure in the Electrical Engineering Department at Princeton University. Shayegan joined the Princeton faculty in 1985, was named a Presidential Young Investigator in 1986, and a Sloan Research Fellow in 1989. He specializes in solid state physics, with emphasis on the physics and technology of electronic materials and devices.

Gerald J. Sussman, '68, PhD '73, (XVIII), has been named the next Matsushita Professor in the Department of Electrical Engineering and Computer Science at MIT. The professorship was endowed in 1976 by Matsushita Electrical Industrial Co., Ltd., of Osaka, Japan, a leading international manufacturer of electrical equipment. Sussman's broad interests include programming language design, electric circuit analysis and design, VLSI, computer science, and artificial intelligence. The scope of his interests is illustrated by a recent collaboration with Jack Wisdom, professor in the Department of Earth, Atmospheric, and Planetary Sciences. Together they demonstrated that the solar system, based on a model developed from their calculations, is chaotic in a mathematical sense. Sussman, a member of the faculty since 1972, is noted for his commitment to teaching first-year students, for the profound influence he has had on the department's curriculum, and for his broader impact on computer science education, with Professor **Harold Abelson**, PhD '73, of 6.001, one of the department's common core subjects. . . . **Amar Gopal Bose**, '51, SM '52, ScD '56, was elected to the American Academy of Arts and Sciences. He was cited for being a "teacher, inventor, and manufacturer of novel quality sound reproducing systems."

VI-A INTERNSHIP PROGRAM

Boston is expected to reach a record high, this June 28th, as I sit in air-conditioned Building 38 and start this draft for the October issue. We've already had several days of unusually high temperatures in Cambridge this spring. Continuing from the last article, there are further awards and honors for VI-A alumni to mention. Our very illustrious alumnus, **Cecil H. Green**, '23, SM '24, adds another kudo to his honor: he was recently appointed an Honorary Knight of the Most Excellent Order of the British Empire by Her Majesty, Queen Elizabeth II. Cecil, born in England, has been a major donor to Oxford University. The honor was bestowed while the Queen was in Houston, Tex., the day after she officiated at a similar ceremony in Florida honoring General Norman Schwarzkopf. Another pleasant acknowledgment for Cecil was his attendance at the University of Texas at Dallas for the start of the construction on The Cecil and Ida Green Center for the Study of Science and Society.

Among the 14 MIT faculty elected to the American Academy of Arts & Sciences at its annual meeting in Boston, was **Amar G. Bose**, '51, SM '52, ScD '56, founder of the Bose Corp. in Framingham, Mass. Amar also established a Bose Foundation Fellowship at MIT, which was awarded this year to VI-A graduate student, **Gregory K. Toth**. . . . **Harold Chestnut**, '39, SM '40, reappears on our list, this time as the 1990 recipient of the ASME's prestigious Rufus Oldenburger Medal. This Medal is given to an individual in recognition of "significant contributions and outstanding achievements in the field of automatic control." I also note (being an IEEE Life Senior Member) that Harold is a member of the IEEE's 1991 Life

Member Fund Committee.

The EECS Department's annual Spring Social and Awards Meeting was held on May 19, 1991, at the Computer Museum in Boston, which was an interesting change of venue. Several VI-A graduate students were honored. . . . Promoted to the rank of Instructor-G was **Tracy M. Clark**, '83, SM '91, for his outstanding assistance to Professor Roberge in 6.302. . . . Receiving the Carlton E. Tucker Teaching Award was **John R. Buck**, '89, '89 (21E). . . . The Frederick C. Hennie III Teaching Awards went to **Victor S. Liau**, '90, SM '90, and **Henry Stavisky**, '55, SM '58, ScD '61, is executive officer of the EECS Department. . . . Many of you know that on an annual basis the Tau Beta Pi Association names a number of seniors as Tau Beta Pi Fellows. One of the 35 selected this year was our **Sanjeev Agrawal**, '91, who was chosen from among 332 applicants nationwide.

Coming up to speak to me several Sundays ago, while I was ushering at my church in Wellesley, was **Harold T. McAleer**, '52, SM '53. Harold was with the General Radio Company (now GenRad) for many years. . . . At Technology Day activities on June 7, I met **Kevin D. Stoddart**, '71, SM '72, EE '73, and his wife, who were attending their first such alumni/ae function. They live in California where Kevin is with Watkins-Johnson. . . . I also talked with **Charles Hieken**, '51, SM '52. . . . In the distance I recognized **William E. Northfield**, '56, SM '57, and later met and talked with **Courtney D. Heron**, '81, SM '83, who's with AT&T Bell Labs in North Andover, Mass.

We've had several visitors to the VI-A office since last writing. I'll list them in alphabetical order. . . . **Alice I. Biber**, '89, SM '90, and **Charlotte E. Biber**, '89, SM '90, were in from Zurich where Alice is with Landis & Cyr AG, and Charlotte is working for Cerberus AG. . . . **Thomas H. Crystal**, '59, SM '60, ScD '66, was attending a conference and is working with DARPA in Arlington, Va. . . . **Edward C. Giaimo**, '74, SM '75, is shuttling between Seattle and Cambridge consulting with AWARE, Inc., in Cambridge, and had an enjoyable lunch with yours truly at Legal Seafood. . . . **James E. Mandry**, '81, SM '83, president of NorTech Electronics of Lawrence, Mass., came in one afternoon for a long chat (and was also seen at the T-Day Luncheon). . . . **Andrew E. Moysenko**, '72, SM '74, with Lockheed/Sanders in N.H., was in for a VLSI conference and stopped by. . . . Lastly, we had a surprise visit from **Michael W. Patrick**, '79, SM '80, who has enrolled at MIT's Sloan School of Management and will be on campus for awhile, so we hope to see more of him.

We are saddened to learn of the death of **Allen K. Wells**, '82, SM '82, as listed in the deceased column of the July 1991 issue of *Technology Review*. In my last contact with Allen he worked for a computer firm here in Cambridge. . . . Don't forget to contact me with any ideas you may have of pertinent activities you would enjoy in conjunction with a 1992 VI-A 75th Anniversary celebration.—**John Tucker**, Dir. (Emeritus), VI-A Program, MIT, Rm. 38-473, Cambridge, MA 02139-4307.

VII BIOLOGY

Mark Rose, PhD '83, has been named an associate professor in molecular biology at Princeton University. Rose does research on the mechanism of nuclear fusion in yeast cells in order to understand the process and regulation of certain cellular functions. . . . Los Alamos National Laboratory has selected **Alan Perelson**, '67, as a Fellow, a top honor recognizing Los Alamos researchers for outstanding contributions to scientific disciplines. Perelson specializes in theoretical and mathematical biology with an emphasis in theoretical immunology. . . . **Stephen J. Elledge**, PhD '83, an

assistant professor of biochemistry at Baylor College of Medicine in Houston, is one of 20 young researchers who have been named 1991 Pew Scholars in the Biomedical Sciences by the Pew Charitable Trusts of Philadelphia. Elledge's research in human cell cycle regulation seeks to learn more about how cells duplicate their chromosomes.

Robert T. Sauer, widely respected for his contributions in basic research and education in the biological sciences, has been named the Whitehead Professor of Biochemistry. Sauer is associate head of the Department of Biology. The Whitehead Professorship was established by MIT in 1982 in recognition of the affiliation between MIT and the Whitehead Institute for Biochemical Research. Sauer and his coworkers apply the tools of molecular genetics, biomedical and biophysics to study the structure and function of proteins involved in the regulation of gene expression. These studies have shaped the way that protein-DNA interactions are viewed by other experts in the field and have begun to unravel the rules by which the one-dimensional information in protein sequences determines protein shape and stability. . . . **Vernon R. Young**, professor in the School of Science, was honored at ceremonies in Washington, D.C., during which he was inducted into the National Academy of Sciences. Young was cited for "his contributions to knowledge of the metabolism of protein and amino acids in humans and of human protein requirements." In addition to his many major visiting appointments at universities across the country, Young also served this past year as president of the American Institute of Nutrition.

Leonard Solomon Lerman and **Uttam Lal Rajbhandary** have been elected to the American Academy of Arts and Sciences. Lerman, a Course VII senior lecturer, was cited for his work in the "intercalation of scridines in DNA, condensed DNA, detection of mutations in genomic DNA by denaturing gradient gel electrophoresis, and affinity chromatography," and Rajbhandary, a Course VII professor, was noted for the "development of key methods for RNA sequencing, sequences and structure-function relationships in tRNA's, and organization and expression of genes in mitochondria." . . . **H. Robert Horvitz**, '68, Course VII professor at MIT, and **Stuart H. Orkin**, '67, the Leland Fikes Professor of Pediatric Medicine at Harvard Medical School, have been elected to the National Academy of Sciences. Horvitz, a Howard Hughes Medical Institute Investigator, has made important contributions to the genetic analysis of the development of cell lineages. . . . **Phillip A. Sharp**, professor and director of the Center for Cancer Research, has been elected to the Institute of Medicine. Sharp is noted for his pioneering work that led to the discovery of surplus DNA.

VIII PHYSICS

Carol T. Alonso, PhD '70, reports: "I have been appointed assistant to the deputy director at Lawrence Livermore National Laboratory. . . . **Ira H. Rubenzahl**, PhD '71, is now dean of academic affairs at Greenfield Community College in Greenfield, Mass. He was the college's assistant academic dean. . . . Los Alamos National Laboratory has selected **John Shaner**, '64, as a Fellow, a top honor recognizing Los Alamos researchers for outstanding contributions to scientific disciplines. "Shaner is a pioneer in shock wave physics. During his 20-year career at Los Alamos and Lawrence Livermore National Lab, he has led groups that received national acclaim for their work in shock-wave and high-pressure physics. Shaner also directed research programs that changed the course of international high-pressure science. In one program he developed techniques to measure the properties of fluid met-

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als over temperature and pressure ranges far greater than those previously accessible, enabling more accurate modeling of systems behavior," states a Los Alamos news release.

M.K. Wilkinson, PhD '50, of the Oak Ridge National Laboratory's Solid State Division has been presented the "Distinguished Associate Award" by the U.S. Department of Energy. Wilkinson was cited for "his neutron research accomplishments, for leadership as director of ORNL's Solid State Division from 1972 to 1986, and for his services as executive secretary of the BES (Basic Energy Services) Program Panel and member of the BES Council on Materials Sciences." He was also recognized for his services as a consultant and secretary to the Steering Committee of the U.S.-Japan Cooperative Program on Neutron Scattering and for accomplishments while serving as organizer and secretary of the National Steering Committee for the Advanced Neutron Source Project.

Martin Klein, PhD '48, has been appointed the Bass Professor of the History of Science at Yale University. The new post is one of 11 professorships endowed by a \$20 million Bass gift from Texan Lee Bass, which also will be used to establish an elective undergraduate program of common studies in Western civilization. Klein, who is senior editor of Albert Einstein's collected papers, has studied the major physicists of the 19th and 20th centuries, including Einstein, Paul Ehrenfest, and Yale physicist Josiah Willard Gibbs. Klein joined the Yale faculty in 1967 after serving on the faculty of the Case Institute of Technology for 18 years.

William A. Jeffers, Jr., PhD '62, associate professor of physics at Lafayette College in Easton, Pa., was recently honored for 25 years of service to the college. . . . David E. Baldwin, '58, PhD '62, has been named associate director for Magnetic Fusion Energy at the Lawrence Livermore National Laboratory. For the past three years Baldwin was director of the Institute for Fusion Studies at the University of Texas at Austin. . . . Patrick A. Lee, '66, PhD '70, the William and Emma Rogers Professor of Physics at MIT, has been elected to the American Academy of Arts and Sciences. He is noted for his work in condensed matter theory and his work on "the transport and electronic properties of materials, especially involving disorder." . . . Francis J. DiSalvo, '66, professor of chemistry at Cornell University, Marc Davis, '69, professor of astronomy and physics and chair of the department of astronomy at the University of California at Berkeley, and Patrick A. Lee, '66, PhD '70, professor of physics at MIT, have been elected to the National Academy of Sciences.

Jerome I. Friedman, the William A. Coolidge Professor at MIT, received an honorary degree from Trinity College in Hartford, Conn. . . . At the MIT Plasma Fusion Center, Physics Professor, Miklos Porkolab, has been named associate director of plasma research, and Dieter J. Sigmar, senior research scientist, has been named deputy director. Porkolab replaces Ronald C. Davidson, who left to become director of the Princeton Plasma Physics Laboratory. Porkolab will oversee the activities of the Applied Plasma Physics and Coherent Electromagnetic Wave Generation Division. He complements D. Bruce Montgomery, who continues as associate director for engineering and technology with responsibility for oversight of the programs in the Fusion Technology and Engineering and Fusion Systems Division. Sigmar will take on a variety of tasks to assist the director, such as negotiating and arranging international scientific collaborations.

Charlotte Meaker Davisson, PhD '48, of Oxon Hill, Md., died on January 1, 1991. She had been a nuclear physicist at the Naval Research Laboratory for many years before retiring. . . . Charles S. Ward, SM '59, of Lexington, Mass., died on May 2, 1991. Ward was employed by

Microwave Associates of Burlington, Mass., for five years before joining Raytheon in 1966, where he was a principal engineer in the missile systems division. A collector who specialized in 19th century U.S. stamps, Ward was a former president of the Boston Philatelic Society.

IX BRAIN AND COGNITIVE SCIENCES

Ann M. Graybiel, PhD '71, Course IX professor, has been elected to the American Academy of Arts and Sciences. She is noted for "discovering neurochemical compartmentalization in brain regions that integrate sensation, emotion, and motion," and for her work in "neurochemical anatomy and theory of related brain function."

X CHEMICAL ENGINEERING

Gordon S.W. Craig, SM '89, a doctoral candidate in Course X, is the winner of the 1991 MIT Japan Science and Technology Prize. The prize, awarded through the MIT Japan Program and made possible by a grant from the Japan-U.S. Friendship Commission, enables the winners to attend meetings in their fields of interest in Japan. Craig plans to speak at a conference in Japan on his research in polymer science. . . . Howard Brenner, the W.H. Dow Professor of Chemical Engineering at MIT, delivered the 1991 Reilly Lectures in Chemical Engineering at the University of Notre Dame. This is the oldest continuing endowed lectureship in chemical engineering in the U.S. Chemical engineering faculty members who previously served at Reilly Lectures are Professors Raymond F. Baddour, SM '49, ScD '51, in 1964 and James Wei, SM '54, ScD '55, in 1973. . . . David H. Bass, SM '81, ScD '83, is now the Eastern Region Physical and Chemical Remediation Specialist at Groundwater Technology in Norwood, Mass. He had worked as a consultant prior to this.

Phillip R. Westmoreland, PhD '86, was presented the first annual "NATE" Award, the Central New England Section of the American Institute of Chemical Engineers Tribute to Excellence. The award recognizes key contributions to his profession by distinguished continuing leadership of the AIChE regional section. An assistant professor in the Chemical Engineering Department at the University of Massachusetts, Westmoreland is past chair and current director of the section. "As further honor," says a press release, "the award has been named after his six-year-old son, Nate Beach-Westmoreland." . . . Godavarthi S. Varadarajan, SM '87, ScD '91, has joined the GE R&D Center in Schenectady, N.Y., as a chemical engineer.

Selim Senkan, SM '73, PhD '77, a professor of chemical engineering at the University of California at Los Angeles specializing in combustion and incineration, has been named the recipient of the 1991 Lawrence K. Cecil Award given by the Environmental Division of the American Institute of Chemical Engineers. Cited for his "seminal contributions in the combustion of hazardous materials," Senkan's research includes experimental and computational chemical kinetics, with applications in combustion, incineration, methane conversion, chlorohydrocarbon pyrolysis and oxidation. The award includes a \$2,500 stipend. Senkan was on the faculty at MIT and IIT before joining UCLA. . . . *Technology & Economics: A volume commemorating Ralph Landau's service to the National Academy of Engineering* (National Academy Press, 1991), has recently been published. The book is comprised of a series of papers that were presented at a Symposium on Technology and Economics in honor of Ralph Landau, ScD '41, for his contributions toward increasing the

understanding of interactions of technology and economics. Landau contributed a foreward entitled "How Competitiveness Can Be Achieved."

The Alumni/ae Association has been notified that **John W. Gaylord**, SM '33, of San Rafael, Calif., died on March 24, 1991, and **Herman Erkku**, ScD '59, of Burlington, Ontario, died in January 1982. There was no further information provided.

XI URBAN STUDIES AND PLANNING

Valerie Edwards, MCP '90, sends word from Roslindale, Mass., "I am social planning consultant at Yale University's Bush Center in Child Development and Social Policy." . . . **Anne D. Aylward**, MCP '75, maritime director of the Massachusetts Port Authority in Boston since 1973, has been elected chair of the board of the American Association of Port Authorities in Washington, D.C. Aylward will be the first woman to hold this position in the 90-year history of the organization. The AAPA, founded in 1912, represents the public ports of the Western Hemisphere, including virtually every U.S. public port agency and the major port agencies of Canada, Central and South America, and the Caribbean. . . . **Irwin J. Kugelman**, SM '60, ScD '63, chair and professor of civil engineering at Lehigh University in Bethlehem, Pa., has been given the Bernard Briody, Jr., Award for distinguished teaching and advising of students. Kugelman specializes in environmental engineering, wastewater treatment, hazardous wastes, and bioremediation. He joined the Lehigh faculty in 1982.

John B. Sheblessy, '30, of Clifton, Ohio, died on December 18, 1990. In his years as a city planner, Sheblessy worked on projects ranging from creating a city from scratch to producing a report that was the basis for freeway planning in Cincinnati. He was a music enthusiast who composed music, played the piano, and performed in several choirs.

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

John C. Gille, PhD '64, writes: "My high-resolution dynamics limb sounder (HIRDLS) experiment to study the chemistry and dynamics of the stratosphere and upper troposphere was recently selected by NASA for flight on the first earth observing system (EOS) polar platform." . . . **Kaye M. Shedlock**, PhD '86, sends word from Golden, Colo.: "I have been the chief of the Branch of Geologic Risk Assessment for the U.S. Geological Survey since 1988. I was recently elected to a three-year term on the board of directors of the Seismological Society of America." . . . **John A. Wood**, PhD '58, associate director of the Smithsonian Astrophysical Observatory at the Harvard Smithsonian Center for Astrophysics in Cambridge, has been elected to the National Academy of Sciences.

Lieutenant Colonel **Harlan K. Saylor**, '42, of Washington, D.C., died on February 16, 1991. After joining the Army Air Corps, he was sent to MIT to study meteorology. He was then assigned to weather forecasting duties for the North Atlantic, serving in Newfoundland, Greenland, and Iceland during World War II. In 1942, he achieved the rank of lieutenant and he was discharged as a lieutenant colonel in 1946. Saylor returned to the Weather Bureau as a trans-Atlantic weather forecaster at La Guardia Airport in New York. After 10 years, he was assigned to headquarters in Washington. He retired as deputy director of the National Meteorological Center in 1988. . . . **Douglas Gridley Brookins**, PhD '63, died on April 30, 1991. Brookins had been a geology

professor at the University of New Mexico since 1971 and served as chair of the department from 1976 to 1979. He wrote hundreds of professional articles on geology and was the author of three books and editor of five. He was involved with several environmental committees and was past president of Congregation Albert.

XIII OCEAN ENGINEERING

From Portsmouth, Va., Commander **Albert F. Suchy**, SM '80, OCE '80, writes: "I have recently been assigned as the commanding officer of the U.S. Coast Guard Naval Engineering Support Unit in Boston. In my new assignment I am responsible for providing support to all Coast Guard cutters home-ported from Maine to Connecticut. Before leaving my post as chief of Fleet Systems and Equipment Branch at the Coast Guard headquarters, I co-chaired a group with the U.S. Navy studying inter-service support integration. The study group was chartered and sponsored by the vice-chief of naval operations and vice-commandant of the U.S. Coast Guard." . . . Captain **John R. McNamee, Jr.**, SM '82, OCE '82, was promoted to his present rank in the U.S. Navy last May.

Lieutenant **Mike Stanton**, SM '89, NE '89, reports: "I am working for the supervisor of shipbuilding, conversion, and repair in Portsmouth, Va., and am currently serving as the project manager for the USS *John Rodgers* complex overhaul." . . . **James M. Averbach**, SM '80, sends word from Newton, Mass.: "I am currently at Thomas Jefferson Medical School in Philadelphia, Pa. I am director of the Laboratory for Applied Computing, implementing knowledge-based system for biomedical research." . . . Commander **Bruce E. Miller**, SM '90, OCE '90, is the new commanding officer of the fast-attack submarine *The City of Corpus Christi*.

The Alumni Association has been notified that **Edward Theodore Clapp**, '47, of Columbia, Md., died on March 24, 1991. There was no further information provided.

XIV ECONOMICS

Jagdish N. Bhagwati, PhD '67, is economic policy advisor for the General Agreement on Tariffs and Trade (GATT) in Geneva, Switzerland. Prior to this appointment, he was a professor of economics at Columbia University in New York City. . . . **C. Roland Christensen**, **David A. Garvin**, PhD '79, and **Ann Sweet** have edited *Education for Judgment: The Artistry of Discussion Leadership* (Harvard Business School Press, 1991). "With its focus on mastering and applying principles rather than memorizing facts, the discussion approach—the foundation of the Harvard Business School's legendary case method of instruction—is especially well suited for professional education: it confronts future practitioners with the same kinds of ambiguous problems they will face in their professional lives," states the book's jacket. Garvin is the Robert and Jane Cizik Professor of Business Administration at the Harvard Business School. . . . **Robert M. Solow**, Institute Professor at MIT, gave a lecture in June at Woods Hole Oceanographic Institution entitled "Sustainability: An Economist's Perspective." . . . MIT Economics Department Professors **Jerry A. Hausman**, and **Paul L. Joskow**, the Mitsui Professor of Economics, have been elected to the American Academy of Arts and Sciences. Hausman is noted for "the Hausman specification test and applied econometrics," and Joskow was recognized for his work on "empirical industrial organization and analyses of industries related to power supplies and health care."

Michael J. Fiore, Course XIV professor, has

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been selected to be the next Skinner Professor at MIT. An expert on labor economics, Piore's research has focused on what he refers to as the social "embeddedness" of economic activity, initially in the labor market and, in recent years, in economic institutions more broadly. He has written on low-income labor markets, international migration, trade unions, and other organized economic groups, internal labor markets, and communities of small, intercontracting firms and network organizations. Dean Philip S. Khoury said that Piore "is an unusually broad and innovative scholar who is widely recognized as a pioneer in the study of internal labor markets (that describe how people advance their careers within business firms) and in the analysis of dual labor markets (in which some people advance their careers over their lifetime and others continue in a static employment situation). He has been interested most recently in the nature of effective management, arguing that the mass-production model used by many American firms should be superseded by the 'flexible specialization' characteristic of many Japanese and European enterprises." Piore has been a member of the Department of Economics faculty since 1966 and currently has a joint appointment with the Sloan School of Management. The Skinner chair, established in 1974, honors the late David Skinner, '23. Skinner was president and vice chair of the board of the Polaroid Corp.

XV MANAGEMENT

John C. McDugald, SM '79, reports: "I retired from the U.S. Army in July 1990 and am presently teaching science at the Bullis School in Potomac, Md."... Paul S. Basile, SM '75, writes: "I've just changed jobs and companies. Again. Seems to be a recurring event. Actually, it had been my intent since joining International Management Institute four years ago to eventually return to industry, which I have now done. I am marketing director for CSC Europe, a subsidiary of Computer Sciences Corp. CSC is a big independent systems integrator, provider of consulting, project management, systems, and software for clients in the U.S. (predominantly the federal government), and Europe. We're growing very fast in Europe, buying companies and changing everything. It is fun. We've moved to London now after 10 years in Geneva, Switzerland. Life in city center is good, if intense. But I still miss baseball."... Hunt Lambert, SM '85, reports: "I am preparing to move back to Denver, Colorado, as executive director of Market Strategy Development for U.S. West. Kelly and I have a wonderful three-year-old daughter named Carolyn. We loved living in the U.K."... Gideon Miller, SM '87, sends word: "After complaining about East Cambridge for two years at Sloan, I have managed to make it all the way to Kendall Square, where I am a manager with Alliance Consulting Group, a corporate strategy consulting firm. No wife, kids, pets, etc., to report, but who knows, one of these days I might surprise everyone (and at least get a pet)."... From Yoonsuh Kim, SM '90, in Seoul, Korea: "I'm working for the Korea Development Institute which is a government sponsored economic think tank. I had a son on February 14, 1991."... Luc Dejonckheere, SM '86, sends word from Munich, Germany: "I've had a change of job after a full four years of management consulting with the LEK Partnership, and joined a dynamic medium-sized German chemicals company (a former client of LEK) as director of finance. On May 15, 91 our little family welcomed Francis, a newborn brother for Sophie who is 7."... From David F. Bunting, SM '79, in Wolfeboro, N.H.: "I'm in my fifth year of executive placement as president of Crane, Reed. Two years ago I transitioned into the international market, most specifically Europe and

Japan. I enjoy a stress-free view of the world from my lake."... Bernard R. Horn, Jr., SM '80, is global portfolio manager for the Freedom Capital Management Corp., a subsidiary of John Hancock Financial Services, in Boston. Prior to this he was the principal of Horn & Company in Cambridge. ... J. Thomas Sellendorff, SM '59, is VP for business development for Sanborn, Inc., in Wrentham, Mass. Previously he was executive VP for Memteck Corp. in Billerica, Mass. ... Jarold W. Boettcher, SM '66, has been named a trustee of the Kansas Public Employees Retirement System. He continues as president and CEO at Boettcher Enterprises, Inc., in Beloit, Kans. ... Gary M. Slep, '63 was honored by the American Society of Safety Engineers as its Region XI Safety Professional of the Year for 1991. Slep is VP and manager of technical services for Sedgwick James of New England, Inc., in Boston. His career in safety began in 1973, and has included safety management positions with General Dynamics Co., United Brands, and Ogden Corp. He has been associated with Sedgwick James since 1986 in several roles within the company's risk management consulting group. ... Paul E. Slobodian, SM '83, has been named VP for Human Resources and Total Quality at Universal Instruments Corp., in Binghamton, N.Y. He will be responsible for personnel, compensation, benefits, training, and development functions. Slobodian has been associated with Universal since 1987. ... Leslie Lynn Rahl, '71, SM '72, founder of the interest rate cap, collar, and floor business and former head of Citibank's Interest Rate Risk Management Department, has formed Leslie Rahl Associates. The consulting firm specializes in interest rate, currency, equity, commodity, and municipal swaps and derivative products. According to a company press release, "the firm is the only consulting firm dedicated to the rapidly-growing \$3 trillion dollar swaps and derivative business."

Sloan Fellows

William R. Thompson, SM '75, sends word from Atlanta, Ga.: "Before resigning as president of BellSouth Systems Technologies, I purchased a portion of the company and took it private. I am now chair/CEO of TransTel, Inc. We have developed and patented (pending) the first wireless communications products for commercial and military use, which give customers the full utility of their voice and data systems, from the 'desk to the universe' under any/all circumstances. The products are in great demand for business/disaster recovery systems, and as a primary service in undeveloped countries."... James G. Foster, SM '90, reports: "I am VP and general manager of Medtronic's Interventional Vascular Business unit headquartered in San Diego, with manufacturing in San Diego, Danvers, Mass., and Kerkrade, the Netherlands. The company is engaged in the development, manufacture, and sale of PTCA (percutaneous transluminal coronary angioplasty) catheters and related products used to treat coronary artery disease. Medtronic, Inc., headquartered in Minneapolis, Minn., is the world's largest implantable medical device company specializing in the cardiovascular and neurological areas."... Richard A. Long, SM '62, sends word from Creve Coeur, Mo.: "I retired July 1, 1990 from Southwestern Bell Telephone Co. in St. Louis. Retirement activities include golf, travel, home improvement/maintenance, and reading."... Tom H. Barrett, SM '69, has resigned as chair and CEO of Goodyear Tire & Rubber Co. in Akron, Ohio. ... Peter D. Fitzgerald, SM '89, is president and CEO of Qualex, Inc., in Durham, N.C. Previously he was general manager for consumer services at Eastman Kodak Co. in Rochester, N.Y. ... James J. Howard III, SM '70, chair of the board & CEO of Northern States Power Co., in Minneapolis, has been named a director at Ecolab, Inc., in St. Paul, Minn. ... Alan

Just When the World Is More Confusing Than Ever—Linc Retires

Lincoln Bloomfield steps to the blackboard. Panelists have just closed the second of two presentations marking the political scientist's retirement from MIT. But Bloomfield still has a few things to say. Chalk in hand, he lists, bottom to top, the words data, information, knowledge, wisdom. He is concerned, he says, about how he can move beyond data and information to produce knowledge in students—and sometimes see them reflect wisdom. Knowledge means integrating information with the experiences and perspectives of students, he says; wisdom is the "values you bring to your knowledge of a subject."

To the assembled audience, it's clear that retirement won't do much to slow Bloomfield's drive to educate. Although he is hanging up his hat as a professor, he'll continue to serve as a foreign policy analyst, consultant, author, and—a recent development—as television commentator. Thousands of MIT alumni/ae know him as the engaging professor of the undergraduate elective, "American Foreign Policy: Past, Present, and Future." But Bloomfield's students also include the scores of high-ranking government and military officials and diplomats he has advised over the years.

Bloomfield joined MIT in 1963, after serving as a United Nations expert in the U.S. State Department for 11 years. He is best known among government officials for the conflict-avoidance games he developed out of that experience. The games simulate foreign-policy crises and allow policy experts and officials to role-play as the national leaders who must respond. Since Bloomfield first experimented with the games in the early 1960s, they have been used by governments and universities throughout the world. The success of the exercises led the State Department to create its own department of gaming five years ago.

Much of Bloomfield's research has been in the areas of arms control, the United Nations, and American foreign policy. He initiated a number of Institute seminars, notably the MIT Arms Control and Global Interdependence Project. In 1979 he served a one-year stint as director of global issues for the



Lincoln Bloomfield with two of his "favorite people," Sir John Thomson, formerly the British ambassador to the U.N. (back to camera), and Diana Bloomfield, his daughter (and tennis partner of choice).

National Security Council. He continues to consult with foreign governments on American foreign policy under the sponsorship of the U.S. State Department; he recently completed his tenth trip to the Soviet Union.

Bloomfield also co-developed the prize-winning CASCON conflict-analysis software, a type of military early-warning system used experimentally by universities and the U.N. He serves on the board of the World Peace Foundation, the National Defense University, and the Canadian Institute for International Peace and Security.

Late in 1989, Bloomfield signed on as host of the television show, *Fifty Years Ago Today*, broadcast weekdays on the Christian Science Monitor network. The program features Bloomfield paging through old issues of the *Monitor* newspaper and commenting ad lib on

stories and related film clips. John Hoagland, CEO of Monitor Television and a longtime friend of Bloomfield's, said the show has "developed quite a cult following around the country."

Bloomfield sees the program as an extension of his teaching. Television is the "vehicle of choice these days, where most people are getting their information," he says. The fact that his classroom has expanded to a national audience is not lost on him. "Frankly, I'm a ham," he admits. "I enjoy the chance to get up on stage."

At his retirement dinner in June, however, Bloomfield had to keep his seat while tributes were heard from undergraduates, fellow faculty, and national officials.

Newly inaugurated MIT President Charles Vest congratulated Bloomfield on his career and said he was sorry to be arriving at the Institute just as such a distinguished scholar was leaving. Vest also read a message sent by another president: "With the gridlock of the Cold War behind us, your life's work is coming into its own in a very practical way. . . . You have educated us all," wrote George Bush.

Elliot Richardson, former U.S. secretary of defense and attorney general, called Bloomfield the "unsung hero" of Operation Desert Storm—three years ago, Bloomfield wrote a game for the State Department in which Kuwait was the target of military threats. Looking back over world events in recent years, Richardson said, "we can only be struck by how things could have been put right with [Bloomfield's] strategic, analytical skills. This suggests a new film, 'Back to the Future'—and Linc will star in putting things right."

Suzanne Berger, chair of the political science department, noted that Bloomfield was one of the "founding fathers" of political science at MIT. When he arrived at the Institute, he joined a "cluster of brilliant, imaginative faculty" that has grown to a 25-member department. Bloomfield's presence, she said, "kept us to the best of what we can be."

Family and friends who gathered for the day of presentations—the theme was "Unconventional Educational
Continued on page MIT 52

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Responses"—and a testimonial dinner could not be surprised that even on the occasion of his retiring from the Institute, Bloomfield's thoughts were on how to improve education. He and a number of graduate students, working through a grant from the World Institute for Peace, continue to develop CASCON with the goal of eventually publishing the software. Each week he tapes five segments of *Fifty Years Ago Today*, and he will continue to consult and write. Not to mention—at a fit 71—work on his tennis game, skiing, singing, piano playing, and myriad other interests.

Still, leaving teaching "is certainly not easy," he says. His departure is unfortunate for the thousands more students who will miss Bloomfield's interpretation of the continuing shake-up of world order. Student evaluations of his most recent courses, which Bergner shared with guests at the testimonial dinner, were as enthusiastic as ever. "Truly amazing," wrote one student. "Funny, interesting, informal." Another student appreciated the chance to "deal in a realm where there is not always an absolute answer." One student put it simply: "Bloomfield for President."—*Lisa Watts* □

The author is a frequent contributor to Technology Review.

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F. White, SM '71, has been appointed associate dean at the Sloan School. As senior associate dean, he is responsible for many of the school's international activities, including the Sloan collaboration with Nanyang Technological University in Singapore, a program to provide market orientation for faculty from the Soviet Union, and a collaborative program with AT&T for senior Chinese managers.

Senior Executives

Andrew C. Knowles, '76, is president and COO of Artel Communications Corp. in Hudson, Mass. Previously he was chair of the board for the University of Massachusetts in Boston. . . . **Harvey L. Weiss, '81**, is now a VP at Thinking Machines, Inc., in Cambridge. He was a VP at Digital Equipment Corp. in Marlborough, Mass. . . . **Thomas F. Burniece III, '87**, is senior VP for engineering at Maxtor Corp. in San Jose, Calif. Prior to working for Maxtor, he was engineering group manager at Digital Equipment Corp. in Colorado Springs, Colo.

The Alumni/ae Association has been notified that **Willard L. Irwin, '57**, of Augusta, Ga., died in 1987. There was no further information provided.

Management of Technology Program

Carol Lemlein, SM '83, reported that her daughter Sandra Hutchings graduated from Brown University in 1991 and was headed for grad school in architecture while daughter Karen, who graduated from Northwestern in 1988, is working for Hewlett Packard in Los Angeles as a marketing communications specialist. . . . **Don Brown, SM '88**, and his wife Marci have finally produced a daughter after having 3 boys. Marcia Elaine Brown was born on June 5, 1991. Congratulations! . . . **Jeff Morrow, SM '88**, is an instructor/consultant in organization and management development at Boeing Commercial Airplane Group. He wrote that he married Ann Tippit on June 10, 1989, and they were hoping to start a family soon. Best Wishes!

Masahiro Yamazaki, SM '88, is corporate VP for R&D at Zeon Chemicals USA, in Louisville, Ky. In May they opened a new R&D building. . . . **Taro Hattori, SM '89**, wrote to us last May with his news. He is busy working on the development of design and manufacturing technology for Geodome, a multipurpose underground dome in urban areas sponsored by the Japanese Ministry of International Trade and Industries. Perhaps he will publish a paper based on data. He is keeping a detailed diary every day so that the process of innovation can be reviewed later. His wife, Chieko, is a counselor of overseas study advisory center at ALC Press, Inc. . . . **Nabil Alyassini, SM '90**, reports that his family is safe and well in California. He had contemplated an offer to return to Kuwait around the end of August but the events of last August changed his plans. Luckily all of his relatives were out of the country at that time. Unfortunately all of his family possessions are presumed lost.

Talal (Jackie) Daair, SM '90, and his family returned to England last July. He received an excellent job offer from an independent oil company called Crescent Petroleum—the only catch was that he would be based back in Sharjah in the United Arab Emirates. After a "look and see" trip, he began work as manager of corporate development in January 1991. . . . **Tom Greaves, SM '90**, is now VP for a small market research and technology assessment firm called Daratech, Inc. He reports that his thesis work led him to this opportunity. That's what we like to hear! . . . **Randall Groves, SM '90**, has been awarded the IBM Corporate Award for recognition of outstanding technical achievement. Congratulations!

Ann Kang, SM '90, went back to Singapore for the Chinese New Year holidays last February. She

has successfully completed her first project with Citibank and is planning the next one which will require her to visit the major trading centers in the Asia/Pacific region.

Peter Tomhon, SM '90, has announced his engagement to Kelly. Congratulations. . . . **Barbara Proud, SM '90**, arrived in Hong Kong on April 2 to take up her new position as coordinator of information technology strategy with the Hospital Authority of Hong Kong. The authority manages 34 hospitals and their associated clinics. . . . **Craig Wall, SM '90**, is now a division chief for maintenance systems and is heavily involved in engineering management policy and responsible for 100+ engineers scattered in many buildings, working on defense projects at Wright Patterson AFB.

Shoichiro Nobori, SM '91, stopped into the MOT office to say goodbye on June 19th. From Boston he was going to visit relatives in NYC and then return to Japan and his position with Mitsubishi Heavy Industries. . . . **Joseph M. Gilman, SM '90**, of Bell South Services is presently working on the Australian Communication Enterprise Project. He says that Australia is a wonderful place to be "stationed" but it's a long way from home and family. He was recently visited by this year's Sloan Fellows, and enjoyed a harbor cruise with them and a fine dinner. Joe had a wonderful time.—*Fay Wallstrom*, Management of Technology Program, MIT Rm. E56-304, Cambridge, MA 02139.

XVI AERONAUTICS AND ASTRONAUTICS

Franklin H. Moss, SM '72, PhD '77, is president and CEO at Tivoli Systems, Inc., in Austin, Tex. Previously, he was VP of the Consulting Service Group at Lotus Development Corp. in Cambridge. . . . **John P. Holdren, '65, SM '66**, professor of energy and resources at the University of California at Berkeley, has been elected a member of the National Academy of Sciences.

Lieutenant Colonel **Eugene A. Wailes, SM '60**, of Fremont, Calif., died on April 19, 1991. He was a professor at San Jose State University for 15 years. Wailes was a member of the Northern California MIT Alumni Association, and the AIAA, and had been a U.S. Marine Corps pilot for 26 years.

XVII POLITICAL SCIENCE

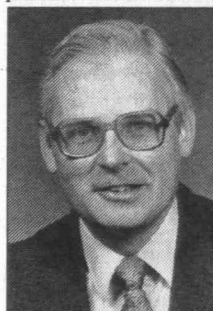
Joseph L. Klesner, SM '83, PhD '88, has been awarded tenure at Kenyon College in Gambier, Ohio. Klesner, an assistant professor of political science, joined the college's faculty in 1985. In addition to other teaching duties, he currently serves as director of Kenyon's international studies program.

XVIII MATHEMATICS

Diarmuid Ó. Mathúna, PhD '62, reports from Dublin, Ireland, that he has written *Mechanics, Boundary Layers, and Function Spaces* (Birkhauser-Verlag, Basel, 1989). . . . A 1991 Current Award for Automatic Theorem Proving was presented to **J Strother Moore, '70**, formerly a professor in the Department of Computer Sciences at the University of Texas at Austin. Moore is credited with co-inventing the Boyer-Moore automatic theorem prover and co-founding Computational Logic, Inc., a company with the long-term view of developing a corporate research environment to support program verification and automatic theorem proving. . . . **Martin Golubitsky, PhD '70**, has received the 1991 Sigma Xi Faculty

Research Award from the University of Houston. According to a university news release, "Golubitsky is among the world leaders in singularity/bifurcation theory, and the book co-authored by him serves as the standard reference source in the field." He also serves as director of the Institute for Theoretical Engineering Sciences at the university.

Gerald J. Sussman, '68, PhD '73, (XVIII), has been named the next Matsushita Professor in the Department of Electrical Engineering and Computer Science at MIT. The professorship was endowed in 1976 by Matsushita Electrical Industrial Co., Ltd., of Osaka, Japan, a leading international manufacturer of electrical equipment. Sussman's broad interests include programming language design, electric circuit analysis and design, VLSI, computer science, and artificial intelligence. The scope of his interests is illustrated by a recent collaboration with Jack Wisdom, professor in the Department of Earth, Atmospheric, and Planetary Sciences. Together they demonstrated that the solar system, based on a model developed from their calculations, is chaotic in a mathematical sense. Sussman, a member of the faculty since 1972, is noted for his commitment to teaching first-year students, for the profound influence he has had on the department's curriculum, and for his broader impact on computer science education, with Professor **Harold Abelson**, PhD '73, of 6.001, one of the department's common core subjects.



Lynn Steen, PhD '65, professor of mathematics at St. Olaf college, has been given an honorary doctor of science degree by Wittenberg University in Springfield, Ohio. In addition to his teaching duties, Steen is project director for National Science Foundation computing grants, associate director of the *American Mathematical Monthly*,

editor of *Mathematics Magazine*, and a contributing editor of *Science News*. Steen serves on the editorial board of the *Wittenberg Review*, the university's undergraduate writing journal.

Sigurdur Helgason, Course XVIII professor, has received the Major Knight Cross of the Icelandic Falcon from the President of Iceland in recognition of his mathematical research. . . . **Robert H. Horvitz**, '68, professor of biology at MIT, has been elected to the National Academy of Sciences. . . . **George Lusztig** and **Daniel Wyler Stroock**, Course XVIII professors at MIT, have been elected to the American Academy of Arts and Sciences. Lusztig was cited for his "contributions to the theory of group representations," and Stroock for "probability theory in the tradition of Feller and Kac, stochastic processes, diffusion theory, and large deviations."

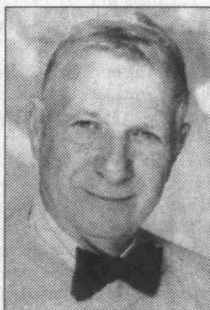
XX APPLIED BIOLOGICAL SCIENCES

Vernon R. Young, professor in the School of Science, was honored at ceremonies in Washington, D.C., during which he was inducted into the National Academy of Sciences. Young was cited for "his contributions to knowledge of the metabolism of protein and amino acids in humans and of human protein requirements." In addition to his many major visiting appointments at universities across the country, Young also served this past year as president of the American Institute of Nutrition. . . . **Joseph Riemer**, PhD '77, has been appointed manager of research and development in the Food and Consumer Products

Division for CRS Sirtine Engineers, Inc., in Greenville, S.C. His responsibilities include marketing the company's expertise in designing, engineering, and constructing projects to the food technology industry. . . . **William Goldman**, SM '64, has been appointed medical director for Schering-Plough HealthCare Products in Liberty Corner, N.J. Goldman was formerly associate director of clinical research for McNeil Consumer



W.J. Goldman



S.E. Charm

Products Co. in Fort Washington, Pa. In his new position, Goldman is "responsible for overseeing all medical activities on new and existing products for Schering-Plough, as well as providing a key interface with regulatory agencies on medical issues affecting the organization," states a company press release. . . . **Stanley E. Charm**, '52, ScD '57, professor of biochemistry at Tufts University in Medford, Mass., is the recipient of the 1991 DFISA-ASAE Food Engineering Award from the American Society of Agricultural Engineers. Charm is recognized for his "pioneer work in irradiation, blood rheology and flow behavior, and drug residues testing in milk, which has resulted in numerous advances in these fields of study."

XXII NUCLEAR ENGINEERING

Michael G. Houts, PhD '91, sends word from Los Alamos, N.M.: "I am currently researching space nuclear power and propulsion systems at Los Alamos National Laboratory. I am also involved with several organizations promoting the exploration and development of space." . . . **Richard R. Sonstelie**, SM '68, has been named COO of the Puget Sound Power & Light Company in Bellevue, Wash. Sonstelie, who continues as the company's president, is a popular choice among environmentalists and consumer advocates for his interest in energy conservation.

At the Plasma Fusion Center, Physics Professor **Miklos Porkolab**, has been named associate director of plasma research, and **Dieter J. Sigmar**, senior research scientist, has been named deputy director. Porkolab replaces Ronald C. Davidson, who left to become director of the Princeton Plasma Physics Laboratory. Porkolab will oversee the activities of the Applied Plasma Physics and Coherent Electromagnetic Wave Generation Division. He complements **D. Bruce Montgomery**, who continues as associate director for engineering and technology with responsibility for oversight of the programs in the Fusion Technology and Engineering and Fusion Systems Division. Sigmar will take on a variety of tasks to assist the director, such as negotiating and arranging international scientific collaborations.

TPP TECHNOLOGY AND POLICY PROGRAM

Burt L. Monroe, SM '90, and Cheryl Blanford, SM '90 (VI), got married on June 29, 1991. . . . **Joseph Raguso**, SM '91, is currently at the Office of Technology Assessment in Washington, D.C.,

where he is joined by current TPP student **Alan Davidson** as a summer intern. . . . **Bridget Vignos**, SM '91, joined the Plastic and Trim Division at Ford in Milan, Mich., this past September. . . . **Michael Lipsky**, associate chair of TPP, is planning on taking a leave of absence for a couple of years to become program officer at the Ford Foundation.—Rene Smith for Richard de Neufville, TPP, MIT, Rm. E40-252, Cambridge, MA 02139.

STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Jill K. Conway, visiting professor of the History of Women, and **Merritt Roe Smith**, the Metcalfe Professor of Engineering and the Liberal Arts, and director of graduate studies, were elected to the American Academy of Arts and Sciences. Conway was cited for her roles as "former president of Smith College and VP at the University of Toronto, social and intellectual historian, author, and board member of major corporations," and Smith for his studies in the "history of technology in the 19th and 20th-century America, and the role of the military in technological innovation." . . . **Bruce Bimber**, a political science doctoral candidate, had a fellowship at the Brookings Institution in Washington, D.C., last year. . . . **David Guston**, another political science doctoral candidate, has been research assistant to the Panel on Scientific Integrity of the National Research Council. . . . **Wade Roush**, STS doctoral candidate, received an NSF Fellowship in the history of science. Roush spent his summer as an intern/contributing writer at *Technology Review*. . . . **Jessica Wang**, received a MacArthur Fellowship for 1991-92 from the Center for International Studies. Wang recently married pol. sci. doctoral candidate Brian Sliker. . . . **Pat Bentley** gave birth to a daughter, Katherine, on May 31, 1991.

Several Knight Journalism Science Fellows (formerly known as Vannevar Bush Fellows) have received awards. **Charles Petit**, a 1984-85 Fellow and science journalist at the *San Francisco Chronicle*, recently received his third major science writing prize in the last six months. Petit's latest award was for an article about scientific explorations of the behavior of matter at the millikelvin and even the microkelvin level. Entitled "Vanishingly Close to Absolute Zero," it was published in *Mosaic* magazine and brought the 1991 Science Writing Award from the American Institute of Physics and \$3,000 in prize money. Petit has also received the National Association of Science Writers Science-in-Society Award and the American Association for the Advancement of Science-Westinghouse Award for a five-part series in the *Chronicle* on efforts to save the Amazonian rain forests in Brazil. . . . **James C. Borg**, of Honolulu, received a AAAS-Westinghouse Award in 1990. He began a year's research on issues of chemical disarmament as an Alicia Patterson Fellow. . . . **Lew Frederick**, of KGW-TV, in Portland, Ore., a Fellow in 1984-85, and **David Baron** of WBUR-FM, in Boston, a Fellow in 1989-90, were selected for Summer 1991 Science Writing Fellowships at the Marine Biological Laboratory in Woods Hole. . . . **Joseph Verrengia**, 1986-87, of the *Rocky Mountain News* in Denver, Colo., and **Laura Tangley**, 1988-89, of *Earthwatch* magazine in Watertown, Mass., joined six other recipients of Kellogg Travel Fellowships on a three-week tour of agriculture, population, and environment research centers in Mexico, Costa Rica, Colombia, and Bolivia organized by the Council for the Advancement of Science Writing.

Note: We are pleased to be included in this Course Notes section and look forward to circulating news about alumni/faculty, and students connected with STS. Please send your news to Phyllis Klein, STS Program, MIT, Rm. E51-128, Cambridge, MA 02139.

MIT LIFE INCOME FUNDS

MR. AND MRS. EDWARD B. WALKER III

HOME: Houston, Texas

CAREER: Mr. Walker earned an S.B. and an S.M. at MIT in geology in 1946 and 1947. He then joined the Gulf Oil Corporation and went on to hold many positions, among them exploration manager for Gulf's operations in Venezuela and the eastern hemisphere, director of the exploration division for Gulf's research and development company, president of Gulf's minerals company, president of Gulf's exploration and production company, and finally president and chief operating officer of the Gulf Oil Corporation. He retired from Gulf in 1984 to become president and CEO of several small family companies.

Mr. Walker has served on the boards or committees of the American Petroleum Institute, of several large corporations and of a number of universities, including MIT, Harvard and the University of Texas. In 1984, he received the MIT Corporate Leadership Award.

He met and married Katherine Miller, a registered nurse and medical record librarian from Montana, in 1953 when they were both working in Venezuela. They have two sons.

GIFT OF CAPITAL: Katherine Miller and Edward B. Walker III (1944) Fund.

QUOTE: MIT was one of the great things in my life. I went as a Charles Hayden Memorial Scholar and I am glad I can give other undergraduates a similar opportunity. The solution to many of the world's problems, I believe, is in education.

For more information about gifts of capital, write or call Frank H. McGrory or D. Hugh Darden at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

Photo: Richard Howard

DONORS' PROFILE



Spent nuclear fuel is temporarily stored in pools of water at a large French reprocessing plant, which separates out the plutonium and "unburned" uranium for reuse. Japan's reprocessing in European plants, as well as at home, could raise international concern because it will require shipment of plutonium, which can be made directly into nuclear bombs.

Japan's Nuclear Dilemma

BY TATSUJIRO SUZUKI

Paradoxically, Japan's ambitious pursuit of energy independence based on a plutonium economy may subject the nation to growing international pressure.

MORE than any other industrial country, Japan is staking its industrial future on nuclear power. Its 39 commercial reactors generate more than 31,000 megawatts of electricity—supplying more than a quarter of Japan's electricity. By early in the next century, reactors now planned or under construction will bring that figure to near 45,000 megawatts, and half of Japan's electricity will have nuclear origin.

These reactors perform as reliably as any in the world: since 1982, Japanese nuclear plants have, on average, operated at above 70 percent of their maximum capacity.

Such success with nuclear power is hardly surprising for a technologically advanced country that has virtually no domestic coal or oil. Nuclear power has been Japan's ticket to energy independence. But these glowing statistics may be obscured by a growing cloud. Not only have recent accidents marred a previously excellent safety record and diminished public confidence, but the Japanese nuclear program's guiding vision—the establishment of an indigenous nuclear power supply using breeder reactors and recycled plutonium fuel—is threatened.

In a nuclear fission reactor, some of the uranium is transmuted into plutonium. A breeder is a special kind of fission reactor that produces plutonium faster than it consumes uranium—in principle, turning nuclear energy into an almost inexhaustible resource. A 1,000-megawatt breeder reactor, for instance, would need an annual input of only about 1 or 2 tons of fresh uranium, versus the 140 tons that a conventional reactor of that size would consume. Spent fuel from a non-breeding reactor can also be reprocessed; unlike breeders, however, such reactors are not designed to maximize plutonium production, and so recycling reduces uranium needs by only about 30 percent.

Many countries—including the United States—made breeders a key part of their nuclear energy strategy in the early 1970s. But most nations have scaled back their breeder plans, for two reasons. First, the fuel they “breed” is plutonium, which can be directly used to make a nuclear bomb. Second, the economics that once made breeders seem a prudent energy strategy have changed dramatically. With uranium supplies ample

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and demand slack, the material's cost has dropped and its availability risen; meanwhile, the cost of extracting plutonium from spent fuel has skyrocketed.

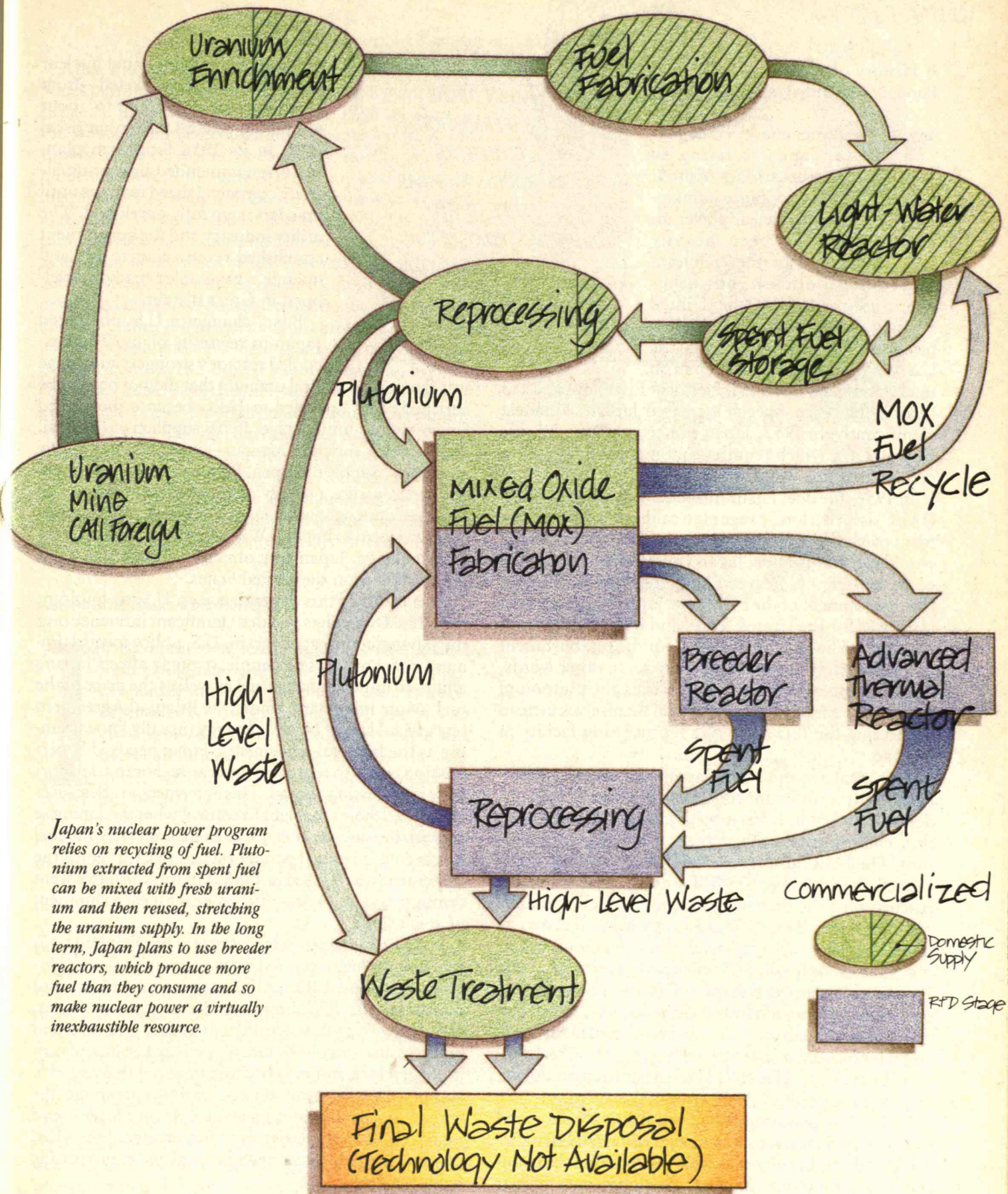
Japan has operated an experimental breeder called Joyo since 1977. A prototype breeder now being built, the Monju, is expected to start operation next year, generating 280 megawatts, and a demonstration reactor is to be built early in the next century. But it is now widely believed that a breeder will not be commercially competitive in Japan until at least 2030.

A breeder makes sense only if the fuel is periodically removed and reprocessed to recover plutonium and “unburned” uranium, which can be recycled. This reprocessing and recycling is the cornerstone of the Japanese nuclear program. But international sensitivity about the potential for diverting plutonium into weapons has led to a tight web of restrictions governing recycling. For Japan to realize its nuclear vision, it must work to assuage these plutonium concerns by adhering to strict international regulations. So far, Japan has done an excellent job of complying. But as the country moves to expand the scale of its reprocessing activities, intending to reduce its foreign energy dependence, compliance will become more difficult. Ironically, then, the more Japan relies on plutonium, the more its nuclear program is likely to be affected by international affairs.

The problem is not unique to Japan. In fact, because of the economic and political risks, Sweden, Italy, Canada, and the United States have chosen not to pursue a plutonium economy. Germany maintains reprocessing and recycling programs, but has abandoned its domestic reprocessing plant. Britain and France, because of their military experience in this area, remain the world's largest commercial reprocessors of nuclear fuel, and both have built new reprocessing facilities. Britain, however, now has no plan for domestic recycling. Even in France, which continues to pursue breeders more aggressively than any other country, the state-owned utility company has been seeking more flexible reprocessing contracts. Many other nations have seriously reexamined the wisdom of a plutonium economy as well. If this trend continues, Japan will likely become the world's largest user of plutonium. Its actions, therefore, will not go unnoticed by the international community.

Japan can still work toward reducing energy dependence through nuclear power. But the country will have to adapt to changing political and economic circumstances. Its success—or failure—could serve as a model for other industrialized nations.

TATSUJIRO SUZUKI, a visiting scientist at MIT's Center for Energy Policy Research, is associate director of MIT's International Program for Enhanced Nuclear Power Plant Safety. He has a doctorate in nuclear engineering from Tokyo University and a master's degree in technology and policy from MIT.



A History of Foreign Dependence

In seeking energy independence, Japan is trying to break free of an almost 40-year legacy. Since its infancy, Japan's nuclear power industry has been heavily influenced by the technologies and policies of other countries—especially the United States. Japanese interest in nuclear power originated in 1952, when the U.S. occupation ended and a ban on nuclear research was lifted. President Eisenhower's 1953 "Atoms for Peace" speech increased Japanese interest significantly. In 1955, Japan enacted its Basic Atomic Energy Law, which requires that nuclear energy be a civilian venture.

In 1956, the new Japan Atomic Energy Commission (JAEC) issued a long-range plan calling for the development of a breeder reactor, which the commission hoped would eventually allow Japan's nuclear program to become self-reliant. Ten years later, the JAEC reaffirmed the development of the breeder as Japan's primary goal (as it was for the United States and other countries at the time). The JAEC also called for the establishment of a completely indigenous fuel cycle. In other words, the Japanese would eventually extract the plutonium from the spent breeder reactor fuel themselves instead of sending the fuel away to a reprocessing facility in Europe.

This goal required that Japan have the capability both to enrich uranium and to reprocess spent fuel, undertakings that have been politically sensitive because they could increase the chances of nuclear proliferation. The JAEC also recommended developing an advanced thermal reactor (ATR) as an "intermediate" reactor until the breeder was ready for full commercial operation. The ATR is a heavy-water reactor. Its main technical advantage is that it can run on uranium that is only slightly enriched. Politically, this Japanese-developed reactor offers the possibility of operating unhindered by the United States, which can restrict what Japan does with fuel processed in the United States or used in any reactor based on U.S. technology. A prototype ATR called Fugen has been producing 165 megawatts since 1978.

In 1967, Japan established the Power Reactor and Nuclear Fuel Development Corporation (PNC) to develop both the breeder and the ATR, marking the country's first strong commitment to develop its own nuclear

*JAPAN NEEDS
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technology. Japan's annual nuclear budget has since skyrocketed—from 12 billion yen in 1965 up to about 410 billion yen (\$3 billion) in fiscal 1991. In its 1956 long-term plan, JAEC recommended importing already commercialized reactors until breeders were fully developed. The utility industry and the government established a consortium to own and operate a gas-cooled reactor developed in Great Britain.

But a change in U.S. policy led Japan to revise its plans. The gas-cooled reactor's strongest advantage

was that it used natural uranium that did not need to be enriched. This appealed to JAEC because the United States—which until the late 1970s supplied virtually all of the world's enriched uranium—would not at that time guarantee a supply for Japan. But when the United States decided to assure a supply of enriched uranium to fuel U.S.-developed light-water reactors (LWRs), Japan's utility industry opted to import LWR technology as its primary reactor design. Japan now obtains well over half of its reactor fuel from the United States.

As a result of this dependence on U.S. technology, the United States has wielded significant influence over the Japanese nuclear program. U.S. policy toward uranium enrichment, for example, strongly affects Japan's ability to import nuclear fuel as well as the price of the fuel. More important, under the Bilateral Agreement on Peaceful Use of Nuclear Energy (usually known simply as the bilateral agreement), Japan needs U.S. permission either to reprocess nuclear fuel or to transport it for reprocessing abroad. This agreement in effect gives the United States the right to control what the Japanese do with the nuclear fuel it sells them even after the fuel has been used in a Japanese-owned reactor. Until the agreement was revised in 1988, Japanese utilities went through a complex approval process for each shipment of spent fuel.

In 1974, India exploded a nuclear bomb it had built using plutonium recovered from a research reactor. This event heightened the political sensitivity of civilian plutonium. In 1977, President Carter announced that the United States would abandon commercial reprocessing and plutonium use, partly because of economic factors, but also because it feared that the U.S. acceptance of plutonium use would encourage the spread of proliferation-sensitive technologies and materials. As a result of this policy change, Japan had to delay start-up of its newly completed reprocessing facility at Tokai.

After intensive negotiations, however, the United States permitted Japan to operate the Tokai plant at full capacity. Even more important, the 1988 revision of the bilateral agreement grants advance consent for Japanese reprocessing or overseas transporting of nuclear materials for up to 30 years, instead of requiring case-by-case approval. Even under the new bilateral agreement, however, the United States still has significant influence over Japan's nuclear power program. The agreement allows the United States to dictate Japan's actions regarding any nuclear fuel used in U.S.-developed reactors—even if Japan bought the fuel from another country. Virtually all the commercial nuclear plants in Japan now use light-water-reactor technology licensed from the United States; therefore, in principle, the United States has a right to intervene in Japan's nuclear activities—especially plutonium reprocessing—whenever U.S. officials deem it necessary.

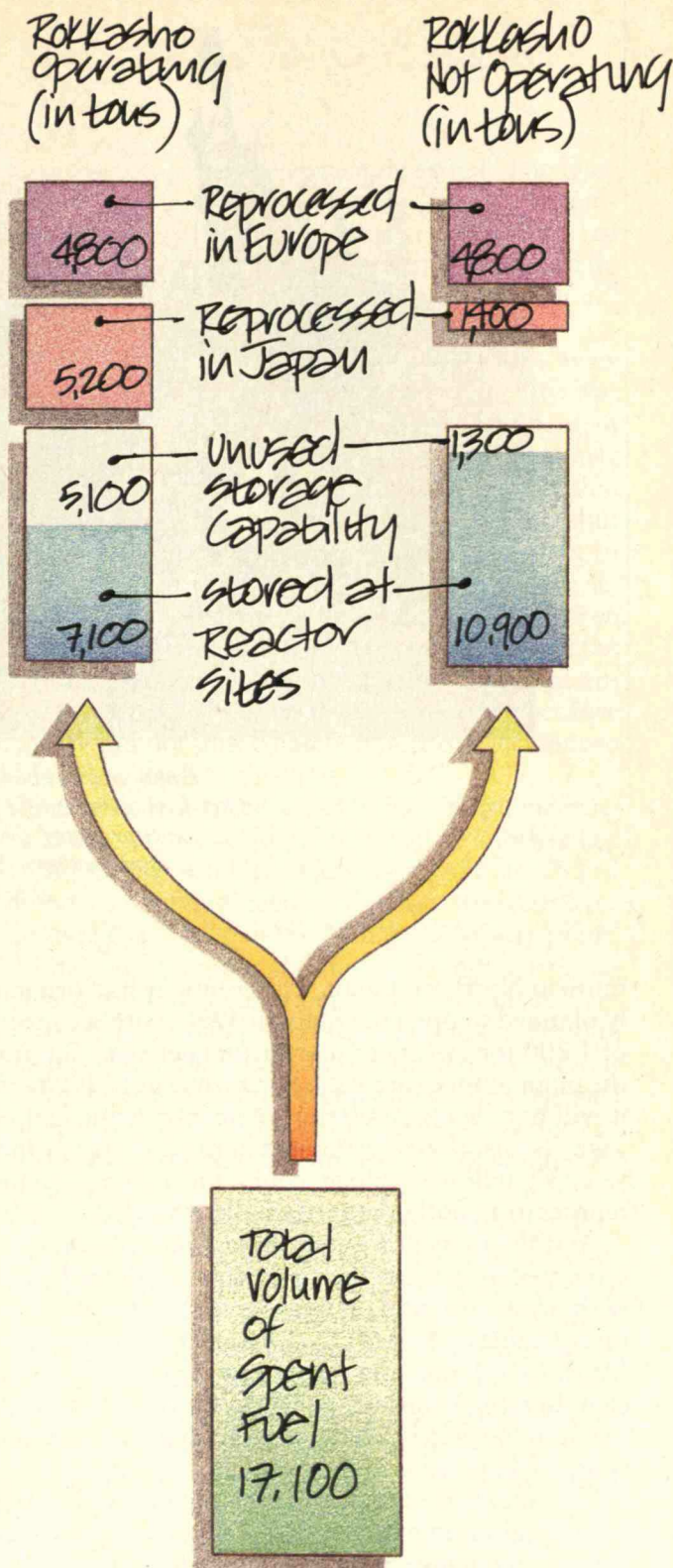
The United States is not the only country on which Japan depends. The starting material for nuclear reactor fuel is “natural” uranium, ore mined from the earth. Two major sources of natural uranium, Canada and Australia, have a similar right to intervene in Japanese nuclear activities.

Plutonium Risks and Benefits

In its commitment to a plutonium-based nuclear industry, Japan is pursuing an option that may, in reality, extend and prolong the country's susceptibility to foreign influence. Japan is also chasing a vision that much of the world has been carefully reexamining, and, for the moment, has rejected as economically impractical. Mainly because of safety concerns, the costs of the breeder and its associated fuel reprocessing and recycling soared so high in the late 1970s and 1980s that most commercial interest evaporated.

In Japan, as in many other countries, the cost of breeder development has escalated dramatically. When originally proposed in 1967, the Monju prototype breeder was supposed to cost 36 billion yen (in current value). By the early 1980s, the figure had risen to 600 billion yen. Although the government heavily subsidized this project, it has already proposed that the utility industry bear most of the cost of building the proposed demonstration reactor.

The fuel-reprocessing facility needed to make the breeder successful has also suffered delays and high cost. The Japan Nuclear Fuel Service, a commercial reprocessing company established by Japanese utilities, decided in 1980 to build one of the world's largest commercial-scale reprocessing plants in Rokkasho-



The more fuel Japan reprocesses, the less it must store at its reactors. If the large reprocessing plant planned in Rokkasho-mura is not available, by 2001 Japan will have barely enough room at its reactor sites to store the used fuel. A completed Rokkasho plant would leave room to spare.



Antinuclear demonstrators oppose the construction of a low-level waste storage facility in Rokkasbo. Once supportive of nuclear power, the Japanese public has grown wary after the Chernobyl accident and recent mishaps at two Japanese reactors.

mura in Northern Japan. The company had originally planned to open the plant in 1990, with a capacity of 1,200 tons of spent reactor fuel per year. But now the plant is not expected to be finished until 1998, and it will handle only 800 tons of spent reactor fuel per year. Its cost is now estimated at more than 1 trillion yen (\$7 billion)—which could mean much higher reprocessing costs than originally expected.

And the costs don't stop there. Once plutonium is separated from spent fuel, it must be fabricated, along with fresh uranium, into new fuel rods—so-called mixed oxide fuel, or MOX. Lacking a plant to produce MOX fuel, Japan must build one, or else rely on foreign sources. Because of its high fabrication cost, MOX fuel is unlikely to be competitive with uranium, which is now inexpensive and abundant.

Economics is only part of the picture. In the long term, plutonium recycling could enhance energy security by reducing dependence on foreign uranium resources. But for the next 20 years, any improvement in energy security could be obscured by the economic and political risks. Although in principle plutonium can be considered an "indigenous fuel," in reality current plutonium programs still depend largely on foreign countries.

For example, because of its lack of domestic reprocessing capacity, Japan made contractual commit-

ments to both Britain and France to finance and use their large new reprocessing plants. Thus Japan will have to ship plutonium from Europe. This is a highly sensitive operation, as Japan realized in 1984 when it transported about 250 kilograms of plutonium from France. Because of concerns over the risk of terrorist attacks or thefts, the shipment was escorted by French and U.S. naval vessels. For the next shipments, Japan will have to provide its own escort ship. Japan may have to rely on foreign suppliers for its MOX fuel, as there is no domestic production capability.

And then there is the possibility of U.S. intervention. Although plutonium shipment is in principle approved by the 30-year prior consent, the 1988 agreement added new safeguards and physical protection requirements on plutonium shipments. Japan must work closely with the U.S. to meet such strict requirements.

Finally, shipment of plutonium could worsen Japan's reputation for environmental insensitivity—a perception that is based on the country's insistence on whaling, its use of porpoise-snaring drift nets to catch tuna, and its importation of endangered species such as sea turtles. Japan can, as these examples attest, be easily attacked by the international environmental community, and it is often forced to change its practices. By entering the plutonium business, Japan may expose itself to significant international pressure.

Accidents and Opposition

Japan must also contend with the protestations of its own citizens. The Japanese public has traditionally supported nuclear power—particularly after the oil crisis of 1973, when reducing dependence on imported oil became a top national priority. In those days, the antinuclear movement was limited to people living near power plants. To quell such resistance, the government began providing funds for economic development in regions where power plants are sited. Utilities also receive money to compensate local fishermen, a policy that has helped tremendously to win community approval.

In 1979, however, the accident at Three Mile Island began to make local negotiations more difficult. In some cases, such as the Maki and Shiga nuclear plants, it took more than 10 years before the utilities submitted official plans to the Electric Power Coordinating Council, which authorizes plant construction. Despite such delays, the general public continued to back nuclear power.

But the 1986 Chernobyl accident invigorated Japan's antinuclear movement. Food contamination in Europe alarmed the public, who now perceived that the potential danger of nuclear power reached beyond the vicinity of the reactor. No longer limited to local siting issues, the antinuclear movement has become more broadly based politically. More than 3 million citizens petitioned the Diet for a "nuclear moratorium."

Although Japan's antinuclear movement then subsided, two recent accidents have rekindled it. The first mishap occurred in 1989 at the Fukushima nuclear power plant complex about 120 miles north of Tokyo. Fukushima, which has 10 reactors on two sites, is owned and operated by Tokyo Electric Power Co., the largest utility in Japan and the largest investor-owned utility in the world. On January 7, 1989, operators manually shut down a 1,100-megawatt reactor because of strong vibration in a recirculation pump. The power company soon found that the pump was partially destroyed and that pieces of it had broken off and flowed into the reactor vessel—an event that threatened to choke off the flow of cooling water.

After an investigation, the Ministry of International Trade and Industry (MITI) blamed the accident on improper welding of the pump component and on the misjudgment of operators who kept the plant running

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NUCLEAR POWER,
AND 46 PERCENT
THINK IT IS
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despite a warning signal. The reactor reopened last November after almost two years of cleanup, safety examination, and intensive negotiation with local governments.

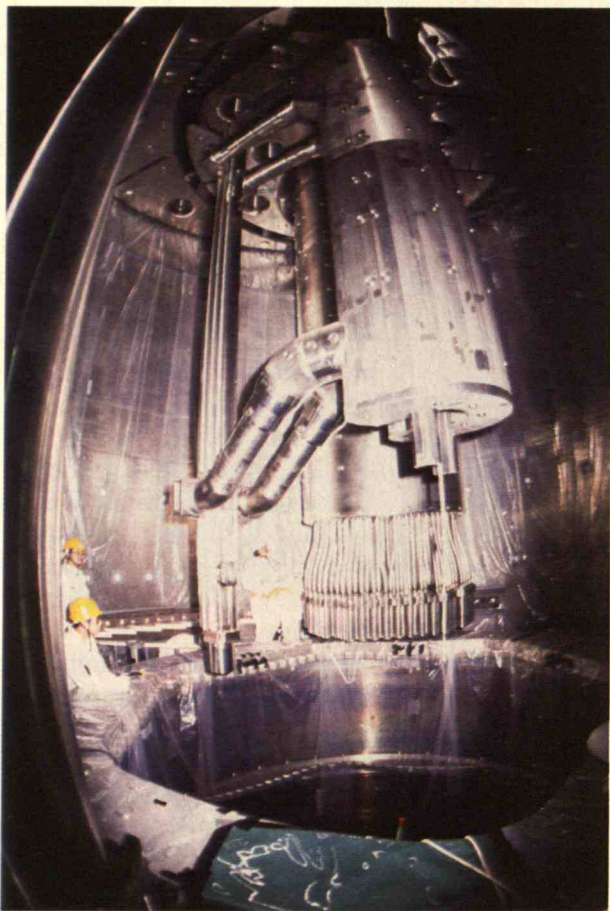
Even though no injuries were reported and no radioactivity was released, the Fukushima incident alarmed many people. Particularly disturbing was the revelation that plant operators had failed to shut down the plant despite learning of the vibrations six days before the accident. The Fukushima site had been

considered a model of successful relations between the utility and the local community. But the accident appeared to have shaken public trust—especially because the utility did not immediately report the accident to MITI and to local authorities.

Three months after the restart of the Fukushima reactor, a more serious accident occurred at another key site. On February 9, 1991, about 20 tons of water leaked from the primary (radioactive) loop into the secondary (nonradioactive) loop at the Mihama-2 power plant, a 590-megawatt reactor about 60 miles north of Osaka. The plant is owned and operated by Kansai Electric Power, the second largest utility in Japan. Despite initial reports, a small amount of radioactivity—about 10 percent of normal annual emissions—was released to the environment. This was the first Japanese nuclear accident that resulted in an abnormal leak of radioactivity from a reactor.

MITI's investigation suggested that the Mihama-2 leak occurred because antivibration bars had been improperly installed. The bars were not subject to the annual inspection, and thus their improper installation was never noticed. MITI ordered Japanese utilities to inspect the antivibration bars on all similar reactors. Kansai Electric discovered installation problems at its Takahama-2 unit and immediately shut down the reactor. Replacing the steam generator is expected to take more than three years.

The accidents have increased the concern of local governments about nuclear power. Officials at two of the country's most favorably regarded nuclear sites are now openly criticizing the utilities' behavior. First the mayor of Mihama complained that he was not notified of a problem until an hour and three-quarters after the incident. Then the Fukui prefecture government, which has been a strong supporter of nuclear power, asked MITI to reexamine its inspection regulations. According to a government poll published in Decem-



Workers install a fuel-handling apparatus at Monju, a prototype breeder reactor expected to begin operation next year.

ber 1990, 90 percent of the public now feels "uneasy" about nuclear power and 46 percent thinks that nuclear power in Japan is "not safe." Although the majority (65 percent) believes nuclear power is necessary, the proportion of the public that favors a larger role for nuclear power dropped below half (48.5 percent) for the first time.

In the long term, the biggest impact of the accidents will likely be the added difficulty in siting new nuclear projects. No utility has managed to find a new site for such a project since the Chernobyl accident. Even projects already under way could be greatly affected. Aomori prefecture, where Rokkasho is located, recently reelected its pronuclear governor—but 56 percent of the vote went to candidates opposed to, or at least skeptical of, nuclear power. The future of the Rokkasho

project is thus still uncertain. If siting problems continue, MITI's goal of building 40 new nuclear plants by 2010 may be very difficult to achieve.

Plutonium's Delicate Balance

At the heart of Japan's nuclear dilemma is the question of how best to manage the supply and demand of plutonium. The Japanese government estimates that by the year 2010, the country will have available about 30 tons of fissile plutonium from British and French reprocessing plants. Japan's own Tokai reprocessing plant will produce at most six tons. The Rokkasho plant, assuming it begins full-scale operation by 2000, can produce as much as 50 tons. Thus by 2010, Japan's total supply of fissile plutonium will be between 80 and 90 tons.

But breeder reactors, which are the principal plutonium "burners," will need only about 30 tons by 2010; advanced thermal reactors could consume at most another 10 tons. Current plans call for recycling the remaining 40 or so tons of plutonium into existing light-water reactors. But such massive recycling of plutonium could raise international concerns. One reason is that the materials-accounting technologies that underlie the nuclear safeguards system may not be accurate enough to cope with such a large-scale operation. Second, any plan that calls for transporting large amounts of plutonium increases the risk that some of the material will be diverted into weapons-making. And while Japan is not itself suspected of harboring nuclear-weapons ambitions, Japanese recycling could set a dangerous precedent for countries that are thought to have such a goal, such as North Korea.

If Japan does not engage in full-scale recycling, the country could accumulate a plutonium surplus. Such a surplus would inevitably raise concerns about the increased risk of proliferation.

Another problem will be in waste management. In principle, relying on fuel reprocessing could reduce the volume of nuclear waste—spent fuel gets recycled rather than disposed of. But if construction of the reprocessing plant is delayed, there will be more spent fuel than Japan has facilities to store it in. MITI estimates that by the year 2001, Japanese reactors will have generated about 17,000 tons of spent fuel. This material is stored temporarily (typically for a few years) at the reactor site and then shipped to reprocessing plants, mainly in Europe. The Rokkasho facility will be able to reprocess 800 tons a year and store 3,000 tons of spent fuel. Even if the Rokkasho plant is built on time, it will not permanently solve the waste problem. And if Rokkasho is delayed, some nuclear plants may run out

of room to store their spent fuel.

Waste management is therefore emerging as a political issue. Technically, it is easy to expand storage capacity, by rearranging the fuel rods as well as by transferring material to larger facilities. Such measures could be politically difficult, however, since agreements with local communities assume that spent fuel will be kept at the reactor site for only a short time.

One option is to remove spent fuel to a central storage facility. But this would likely cause fears among local citizens that the facility would become a final repository for the waste. Some countries use alternative methods of waste handling, such as on-site dry cask storage. Japan has not implemented such schemes, however, primarily out of the reluctance to stir up community opposition.

Besides spent fuel, Japan must deal with the high-level radioactive waste that will soon be returning from European reprocessing plants. Although the Rokkasho plant can store this returned waste, there is no specific plan for long-term disposal. A scheme to build an engineering test center to store high-level waste in Horonobe, on Hokkaido, has been delayed by Hokkaido's socialist governor, and last year the Hokkaido Diet voted against the project. Another proposed plan was also canceled because of local opposition.

Searching for Solutions

If public concern over reactor safety and waste management, as well as international pressure to protect the environment and prevent the proliferation of nuclear weapons, continues to build, Japan will probably have to shift its nuclear energy priorities. Japan's original nuclear vision, although perhaps a valid long-term goal, may not be achievable on the timetable currently planned. Large-scale use of plutonium appears no longer to be necessary, thanks to plentiful uranium. The large investments needed to realize the current goals could make the Japanese nuclear program more inflexible and increase its susceptibility to international pressures.

The Japanese Atomic Energy Commission will soon start discussions on revising its Long Term Development Plan. This is an opportunity to reexamine the policy and search for alternatives that reflect the changes in the economic and social conditions surrounding nuclear power over the last decade.

Even though there is no need to commit now to full-scale use of plutonium, Japan can and should continue

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technological development of breeders and reprocessing as part of its strategy of preparing for the uncertain future. Many countries, including the United States, have taken this approach. The scale and pace of reprocessing can be adapted to meet reduced plutonium demands. These changes in reprocessing plans will require building, or allocating, more space to store spent fuel.

To ease public concerns further, Japan should give priority to improving the safety of existing reac-

tors and to developing reactors that are safer, less expensive, and more resistant to proliferation, and that make waste management easier. An example is the U.S.-developed "integral fast reactor," a compact plant incorporating both a breeder reactor and a fuel-reprocessing facility. Because plutonium bred in the fuel rods need never leave the premises, fuel is far less likely to be diverted into the wrong hands. Japan should search for other technological options to increase the security and flexibility of its nuclear program.

Japan can strengthen its nuclear power strategy by actively participating in international efforts to control proliferation. The country has shown some encouraging signs that it is taking this responsibility seriously. For example, Japan is insisting that North Korea accept the International Atomic Energy Agency safeguards as a condition for resuming diplomatic relations. In 1985, Japan similarly forced China to accept IAEA safeguards as a condition for the Japan-China Cooperation Agreement on Peaceful Use of Nuclear Energy. Now, Japan is asking China to join the nonproliferation treaty.

Japan has also suggested new rules to strengthen the IAEA safeguards system. One idea is to permit the agency to inspect all nuclear facilities without the prior consent of the host country; this would be particularly useful in dealing with countries strongly suspected of misusing nuclear materials and technology. (Iraq's recent attempts to evade IAEA inspections increase the chance that Japan's modification will be accepted.) And Japan has introduced new foreign-aid guidelines that will cut off money to countries that have not signed the nonproliferation treaty or that are thought to be developing weapons of mass destruction.

To some Japanese leaders, any policy change seems like a threat to existing programs. But while consistency is certainly an element of success, other considerations need to take priority. Japan's nuclear policy will remain credible only if it reflects new realities and reduces economic and political risks. ■

Die yellow house
Ein Baum und ein Baum
zusammen in die Hand
reichen und müssen im Wald
immer eine hohle Erde, wo
verfäbren.



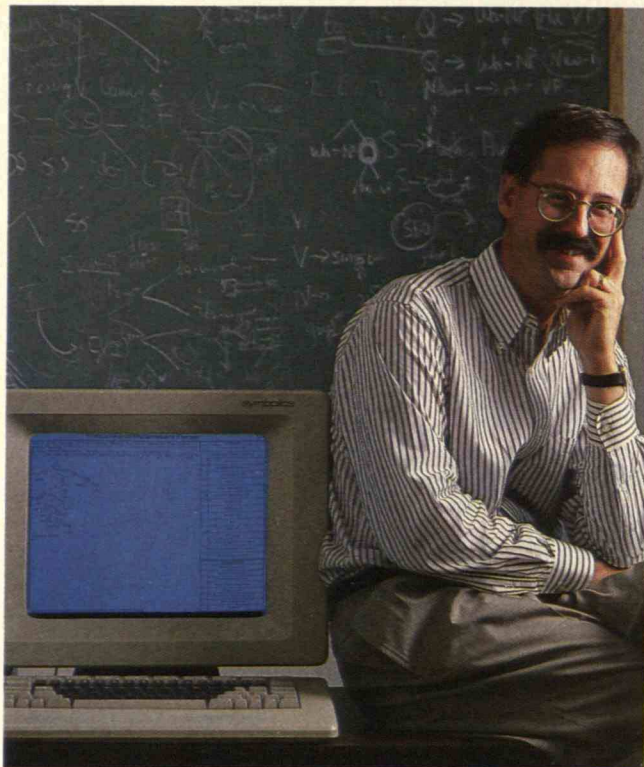
*A new generation
of computer programs is
verifying Noam Chomsky's
long-controversial theory
that the principles of
human language are innate.
It's a project that raises
questions about
the mind itself.*

Language Busters

BY BETH HORNING

COMPUTER scientist Robert C. Berwick of MIT's Artificial Intelligence Laboratory says the research he and his colleagues are doing represents a "real revolution." Perhaps the most ambitious effort is a computer program by Berwick's graduate student Sandiway Fong—it can already "parse," or diagram, sentences in English, and parsing in languages as disparate as Spanish, German, and Japanese is well under way. Not only that, but the program handles all the languages with the same set of about 25

Chomsky holds that we develop language naturally, much as we grow arms and legs.



Robert C. Berwick heads up a group of MIT researchers who are using "universal-grammar" theory to parse English, German, Spanish, Japanese, and the Australian aboriginal language Warlpiri by computer. In some cases, they can do rough-cut machine translations as well.

bare-bones rules. And it can take on amazingly complicated syntactic constructions—as well as the same awkward, ill-formed language that everyone produces every day and that everyone else somehow understands. By contrast, most other computer programs that analyze grammar incorporate hundreds of complex rules for every conceivable type of sentence in however many languages they're geared for. Then, after all that, they work only with relatively simple prose.

Like all the other work from Berwick's group, Fong's program is based on a theory that dates from 1957, when fellow linguist Noam Chomsky, also at MIT, published the book *Syntactic Structures* and changed his field forever. Before he came on the scene, researchers viewed language almost exclusively as a collection of habits acquired through conditioning. Learning to speak was supposedly like learning to ride a bike or catch a ball—you observed, tried, and tried, tried again. Chomsky disagreed violently, arguing that language is based on broad structural principles, the knowledge of which is innate in human be-

ings, part of our genetic endowment.

What that means is that each of us develops language naturally in the normal course of events, much as we grow arms and legs, Chomsky went on. Our experience in the world does not supply linguistic knowledge but simply awakens and enriches it. Accordingly, he maintained that all languages, however different they might seem, share common parameters—a "universal grammar."

Such ideas have gained acceptance in many circles over the years but remain controversial. One reason is that they assume there's such a thing as human nature: although this notion is coming back into vogue in the social sciences, you still don't have to look far to find a psychologist or a sociologist who insists that our minds are shaped solely by our environment.

Yet Chomsky has raised hackles even among those who do believe in human nature, because of the particular definition of human nature that his theory presupposes. He believes our minds are inherently "modular," consisting of separate systems such as his personal favorite, the language faculty. All the systems have their own properties and are independent of any basic learning mechanisms—if indeed such mechanisms exist, Chomsky hastens to add. The very idea is anathema to legions of researchers who have spent their careers trying to define and assess general intelligence.

Fong's parser would seem to lay many of these quarrels to rest. After all, it relies entirely on principles of universal grammar, and it's an ordinary computer program that is about as modular and disconnected from basic learning mechanisms as you can get. Other people have built similar systems—Berwick estimates there are about half a dozen worldwide—but this one alone can take a wide range of sentence types and deal with multiple languages. What's more, it works. You sit down, type in an English sentence, and wait a few seconds while some boxes in a column on the righthand side of the screen flash on and off. Before you know it, a precise grammatical analysis leaps into view. Then you make a few minor adjustments that enable you to do the same with a sentence in Japanese or German or Spanish.

Michael Kashket, another student of Berwick's, is using a similar approach to do electronic parsing of the Australian aboriginal language Warlpiri, whose almost arbitrary word order poses a special challenge to universal-grammar theorists. And yet another student, Bonnie Dorr, has made inroads into computer translation, devising a program to perform that feat between English, Spanish, and German for some kinds of sentences. Chomsky himself, who's hardly prone to empty praise, calls the achievements of Berwick's group "impressive." They bring linguists closer to understanding how language works. But just how much closer is still a matter of debate.

BETH HORNING is an associate editor of Technology Review. She has master's degrees in English and education from Indiana University.

"To Decode, Hold This Message Up to a Mirror"

Roughly two years ago, when Berwick started to explore computer applications of universal grammar, his first goal was simply to see if anyone could pull it off. Several people had suggested that it just wasn't possible.

What gave him the nerve to proceed was not only his faith in Chomsky's ideas themselves but his interest in how they have evolved through the efforts of linguists all over the world. In the early days of work on universal grammar, he observes, linguists—including Chomsky—still didn't know how to get to the deep levels of language to actually see the broad structural principles that the theory assumes. But these researchers kept tinkering away, and finally, in 1981, Chomsky came out with *Lectures on Government and Binding*, which puts decades of small but significant advances together into a coherent whole.

The refined "principle and parameters" version of universal grammar possesses a compelling simplicity and elegance, Berwick notes. For example, in the theory's previous incarnations, rules had a daunting task—they were supposed to describe both the underlying syntactic structure of a sentence and the roles of the various words. The new, improved work, on the other hand, recognizes that structure can be considered by itself.

This key insight makes computer parsing on the basis of Chomsky's theory much more feasible. One part of a program can zap through a number of possible "tree diagrams"—the diagrams used to map syntax—and other parts can test out the words to see if there's a way to hang them all on any one diagram and still not violate certain grammatical constraints. When the program finds the tree diagram that can accommodate every word and every constraint, the sentence is parsed.

The realization that structure can be considered independently has also yielded another discovery, one that makes the job of a computer parser easier still: for all the world's languages, there are two fundamental types of structure, each the mirror image of the other. The first type is the structure used in English, where verbs tend to begin verb phrases, nouns noun phrases, prepositions prepositional phrases, and so on. Thus in a straightforward English sentence such as "The pencil on the table is red," the noun "the pencil" marks the beginning of the noun phrase "the pencil on the table." And that noun phrase contains the prepositional phrase "on the table," which, predictably enough, starts with the preposition "on." Finally comes the verb phrase "is red."

The other type of structure is found in languages like Japanese, where certain important ordering principles are reversed. Here verbs, for instance, are at the end of verb phrases instead of the beginning—while English speakers say "Japanese eat sushi," Japanese speakers say "Japanese sushi eat." As young children, human beings

presumably can adapt to either of the two fundamental structures. Chomsky speculates that it's as if there were an array of switches in everyone's head. These switches get set one way for those who grow up hearing Japanese, and they get set the other way for those who grow up hearing English. With a principle-and-parameters parser, the switches can be set and reset with a few keystrokes.

That leaves the problem of how to hang the words of a given sentence on its appointed tree diagram. The series of 25 or so grammatical constraints that the programs from Berwick's group consult to accomplish this feat also comes from *Lectures on Government and Binding*. Berwick compares these rules to atoms: they can combine to give you a compound that's very complex, he remarks, but taken by themselves, they're quite simple.

For example, one constraint dictates that subjects and objects must receive "case," which helps define the part they play in a sentence. Subjects of a main verb receive one kind of case, objects of it receive another, objects of prepositions receive yet another, and so forth. A second constraint specifies that verbs must assign "thematic roles" to particular words—typically cues that say who (or what) did what to whom (or what). Exactly what kind of thematic roles are called for depends on the defi-



When Chomsky introduced the theory of universal grammar in the 1950s, academics were so hostile to it that he could hardly find a decent job. Now many people agree that without his ideas, linguistics would be in the dark ages.

inition of a specific verb. The verb "eat," Berwick explains, implies both an eater and a thing eaten, whereas "put" implies not only a "put-er" and a "put-ee" but a place where the put-ee is put. He points out that "John put the book" is odd, that it needs something like "on the shelf." A principle-and-parameters parser, consulting its built-in dictionary, is apprised of this and looks for a word or phrase within the sentence that fills the bill.

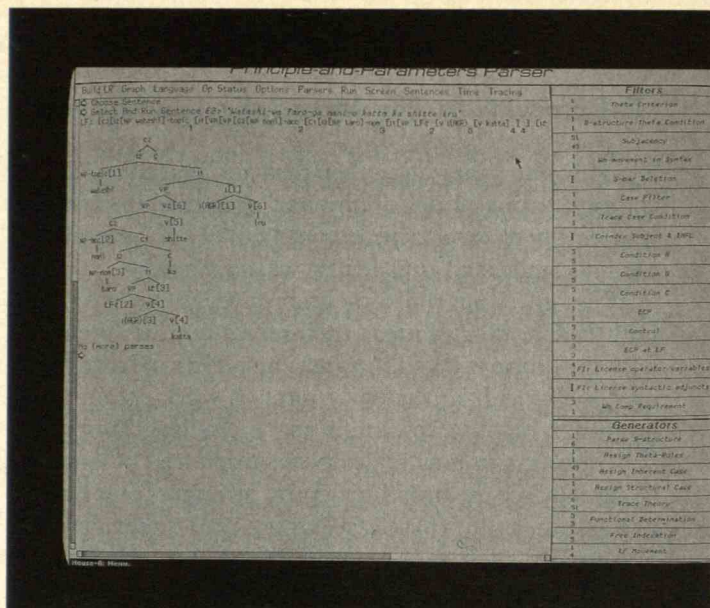
And parsing paves the way for computer translation, since it lays the structure of a sentence bare. Chomsky's theory holds that all human languages are spoken and written with reference to the same handful of grammatical constraints, so translation becomes just a matter of finding out how those constraints might determine the structure of a sentence in a second language, and how words in the second language might fit within the structure.

Beyond Subjects and Verbs

As excited as Berwick is about the projects he and his students have been laboring over, he's up-front about their limitations. For translating, the principle-and-parameters approach compares favorably with the competition, he asserts, but he also admits that that's not saying much. Researchers have been trying to get machines to do translations since the early 1950s, when the Air Force decided this might be just the thing for intelligence gathering—the difficulties have proved far more formidable than anyone had anticipated. Enlisting the insights of universal-grammar theory doesn't eliminate those difficulties; it just cuts down on some of them. Ask Berwick whether computers could ever replace humans as translators and he'll simply smile and reflect that it's an interesting question.

He acknowledges, for instance, that as good as principle-and-parameters programs are at teasing out syntactic structure, they hardly even touch on broad questions about what any sentence might actually be saying. In other words, the whole conceptual world that a sentence calls up in our minds—the cultural nuances, the ambiguities, the shades of meaning—remains largely terra incognita. And it's just that conceptual world that many of Chomsky's critics, stressing the environmental influences to which we are subject, have faulted him for ignoring.

However, Chomsky contends that a lot of so-called broad questions end up having less to do with environmental influences than people think. He'd never deny that culture has a role in shaping thought—and he seems even more leery than Berwick about making grandiose claims for any program's possibilities as a translator—but he's convinced that much of our conceptual universe is coded into our genes along with the principles of syntactic

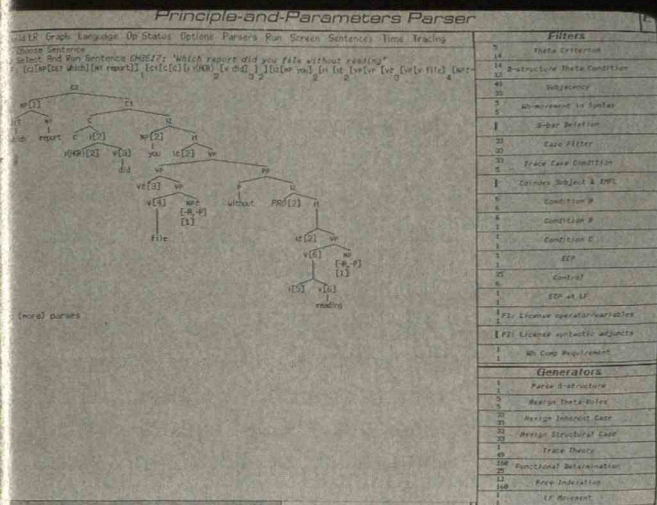


structure. It's all part of our language module and so intrinsic to our being that no translator, machine or human, even has to deal with it.

He points to the word "climb." If you think about it, he says, you soon find that this concept is not so easy to explain. It's often something people do with their feet and legs, yet they can also do it with their hands and arms. It often means going up, yet it can also mean going down. The definition, in short, is more complicated than you would ever imagine. "But every child learns it perfectly right away," he observes. "Now that can only mean one thing. Namely, human nature gives us the concept 'climb' for free." He goes on to submit that the same is probably true for most concepts embodied in words. "This is the way we learn language. We simply learn the label that goes with the preexisting concept."

And among the preexisting concepts we find labels for are many that generate the underpinnings of sentence structure—concepts such as those that include some notion of causality. Thus syntax can extend far beyond what everyone was taught in school about subjects and verbs and relationships between pronouns and their antecedents. "Syntax in a wider sense," Chomsky points out, "is the study of symbolic systems. It's the study of how one sentence can imply another. For example, if I say 'John killed Bill,' it implies the sentence 'Bill is dead.' We understand the implication because we are born knowing not only about death but about causality, both of which are bound up in our word 'kill,' whose definition is 'cause to die.'"

Working on the Lexicon Project, a long-standing linguistics research program at MIT, Chomsky's colleague Ken Hale investigates sentences from this perspective, and he seconds the notion that there's more to syntax than meets the eye. Hale has been taking a long, hard look at expressions like "bank the money," which happen to



Sandiway Fong, one of Berwick's graduate students, has developed a computer program that parses sentences by forcing them to run the grammatical gauntlet shown on the right-hand side of both these screens. For even the most complex constructions, a syntax-mapping "tree diagram" appears in a matter of seconds.

According to universal-grammar theory, there are

two fundamental types of syntactic structure for all the languages in the world, and here the program takes on sentences in languages that represent each of those types: English (right) and Japanese. The Japanese sentence, which means "I know what John bought," translates literally as "I John what bought know" and has a tree diagram that's the mirror image of the same sentence in English.

raise some vexing issues. You can say "bank the money" but not "church the money." Why?

To many people, the explanation would seem to be that the profound cultural meanings attached to banks and churches make such an utterance impossible. Yet Hale has discovered that at a deep level, "bank the money" takes on a syntactic structure very different from the one "church the money" would if we were capable of saying such a thing. "Abstractly, 'bank the money' can be represented as something like 'cause the money to go into a bank' or 'put the money in a bank,'" he notes. "But we don't put our money in a church. Instead, we give our money to it, and the syntax of that phrase is just not the same."

Still, even if all languages do share universal principles and concepts, that doesn't necessarily mean those principles and concepts are innate. Recent articles in newspapers and such magazines as the *Atlantic* and *Scientific American* seem to suggest an alternative explanation. Vitaly Shevoroshkin, a linguist at the University of Michigan, believes every language on earth probably evolved from a single ancient tongue spoken in Africa anywhere from 50,000 to 150,000 years ago.

Linguist Joseph Greenberg of Stanford agrees. Greenberg has been comparing families of languages ever since the 1950s, and in 1987 he published a bold work that classifies the 1,000 or so languages of the Americas into just three groups. Now he has devoted himself to classifying Indo-European languages. Once he's done with that, he says, the next step will probably be to "sort of finish up the whole world," fitting all its languages into larger and larger groups until everything is traced back to the source he's confident exists.

His disciple Merritt Ruhlen is eager to tackle that problem. Ruhlen, who got his PhD in linguistics from Stanford but decided to opt out of traditional academic

life, wants to reconstruct that original language spoken in Africa eons ago. And Vaclav Blazek, a Czech high school teacher, is working independently toward the same goal. Blazek is self-taught, yet his grasp of languages is comprehensive enough to earn him the respect of linguists of the Moscow school from which Shevoroshkin comes.

Surprisingly, Hale doesn't think these ideas are so off the wall. The languages of the world probably did all come from a common source, he agrees, although he goes on to say that he suspects the search for evidence to support the hypothesis will be futile: languages change constantly and fast, which poses major problems for anyone who wishes to trace anything back so far.

However, just because the similarities among languages might have a historical base doesn't mean they don't have a biological base as well, he points out. The mutation that gave rise to linguistic ability might have occurred only once and spawned a single language to which all others are ultimately related. Chomsky adds that the history of language is irrelevant to anyone's childhood task of picking up English or German or Swahili. No matter what happened linguistically thousands of years ago, all human beings who are born into the world still have to master a language all by themselves on the basis of what is, when you stop to consider it, rather limited experience. In other words, Shevoroshkin and Greenberg don't really challenge universal-grammar theory at all.

Journey to the Center of the Brain

The same cannot be said of Philip Lieberman, chair of the Department of Cognitive and Linguistic Sciences at Brown University. Lieberman affirms that some aspects of language are innate in human beings, and he also thinks the research from Berwick's group could go a long way toward corroborating this. But he cautions against

Critics of universal-grammar theory charge that it fails to take our evolutionary heritage into account.

accepting universal-grammar theory whole hog, and not just because it tends to downplay the importance of environment. He argues that human nature, which he believes in at least as strongly as Chomsky does, is much more complex than such a theory implies.

To understand what goes on when we use language, we have to take our evolutionary heritage into account, he explains. And once we do, Chomsky's central ideas about what the brain is like begin to break down—the organ cannot conceivably be as modular as he thinks. For one thing, the specialized mechanisms we have for “higher,” more complicated activities have evolved from those for more basic tasks. Thus the same areas of the brain that regulate body temperature and control skeletal muscle figure prominently in memory. They play a role in our ability to feel pain and pleasure, too. “The brain mechanisms that make human language and thought possible probably also continue to participate in older, simpler activities,” Lieberman writes. “Extreme modularization is most unlikely.”

Studies of brain-damaged patients back him up. For example, harm to the basal ganglia, a part of the brain associated with motor activity and derived from our reptilian past, produces speech, language, and cognitive deficits.

Lieberman charges that universal-grammar theory shortchanges the role of learning as well. Some of our apparently innate knowledge might actually come from the general learning mechanisms Chomsky is so dubious about, he says. As evidence, he cites work with “distributed neural networks,” computer architecture designed to mimic the biological circuitry of the human brain.

Such research indicates that we formulate broad principles from sets of slightly different examples and then use those principles to make sense of our experience. For instance, Lieberman observes, the systems can “learn” to identify dogs by “extracting a prototype construct of dog-giness” from a collection of pictures of “dogs and other quadrupeds.” He sees no reason why the same kind of process might not contribute to language acquisition.

One Chomskyan rebuttal would be that the language to which children are exposed is too imperfect to provide them with workable principles of grammar, but according to Lieberman, imperfection doesn't matter. For these purposes, sentences would need to be grammatical only about 60 percent of the time.

Chomsky, however, remains unimpressed with neural networks and what they seem to suggest about learning. “You can take those proposals seriously when they become concrete,” he says. “Yes, maybe there are techniques we use to formulate principles, but let's see them. If you can give me some that yield the principles Berwick and his students are using in their computer programs, fine—we have something to talk about. But not until then.”

He's even more dismissive of Lieberman's thoughts about modularity. “Lieberman is missing the point,” he remarks. “It could be that a section of the brain, a particular piece of meat, is involved in diverse functions, but that has nothing to do with what I'm saying.” The gist of his ideas, he explains, is that parts of the brain work together in one way to accomplish a task like talking and another way to accomplish a task like crossing the room. A module is a mode of organizing neural responses, not a concentration of neural tissue.

Creativity and Rules

What such tight arguments don't completely address is the subjective experience of language. Granted, part of that experience is the lightning speed with which we grasp complex verbal constructions, and Chomsky's ideas do give us a way to understand this: if we're born with a module for linguistic knowledge, then such a phenomenon is almost inevitable. But there's also the question of how our thoughts and reactions come into play, and that's one area where Lieberman's views are compelling. Anyone who's waxed unnaturally articulate during an argument is prone to suspect that aggression and other primitive impulses must somehow be intimately connected to language mechanisms.

On the other hand, just as Chomsky acknowledges that cultural and environmental influences exist, he's aware that thoughts and reactions are part of our lives. He notes, though, that it's simply not useful to put together theories about subjects we don't understand, and thoughts and reactions come under this heading.

While Lieberman strives for a vision of human nature that integrates every aspect of our experience, Chomsky is concerned about the violence we might do to truth by defining anything too soon. He maintains a respectful distance from what he feels we aren't equipped to know yet: he agrees that there must be some relationship between language and everything else going on in our heads, but he won't presume to say what it is. Instead, he trains his attention on a more immediate question—how human beings are able to express their thoughts and reactions in endlessly novel yet entirely appropriate ways. In conversation, for example, two people may agree, but they certainly don't say the same thing verbatim.

It's a focus that's consistent with his radical political philosophy, which has earned him even more fame than his work in linguistics. An avowed anarchist, he places a high value on personal autonomy. He believes that social cooperation can flourish largely without coercion from the state—that, in fact, the state should stay out of such matters as much as possible. He's convinced that all human beings are possessed of a drive toward creativity, which expresses itself not only in art but in everyday

life. Put simply, Chomsky holds that each of us, as human beings, has an almost incorrigible tendency to respond to things in our own way.

The idea that we're all born with the same mental hard-wiring may seem to contradict this, but according to MIT political scientist Joshua Cohen, who has written at length on Chomsky's social thought, just the opposite is true. Cohen observes that for Chomsky, the "intrinsic structure" of the human mind—the mental hard-wiring itself—is what "underwrites the possibility of creative activity." It does so just by establishing a context within which to exercise such activity: a shared human framework. In other words, it sets up the parameters that not only give form to our efforts but allow others to understand them. Without parameters, any attempt to communicate, whether it's *Moby Dick* or a request for an extra bag of kitty litter, degenerates into meaningless noise.

Not surprisingly, then, it's linguistic parameters per se that continue to engage Chomsky's energies, not so much the substance of what people say to one another. When it comes to the computer programs from Berwick's group, he seems almost bored by the prospect that any of them might do translations. He's not animated until he's talking about their parsing abilities, which, he says, have sharpened universal-grammar theory. For example, Berwick and his students have an easy way of knowing when a principle they're working with is poorly defined: it produces a bad parse. Also, the slight adjustments they need to make in a program when they want to parse in different languages shed light on how those languages may vary within the confines of universal grammar. "The study of parsing," Chomsky points out, "is very likely to tell you things that will be of interest about the nature of language." And that, after all, is what he's been trying to do for more than 40 years. ■





To integrate new manufacturing equipment smoothly, plant managers need to set aside time and space for problem solving away from the pressures of routine production.



Managing Innovation on the Factory Floor

BY MARCIE J. TYRE

IN December 1982, a factory in Alton, Pa., installed a new high-precision machining line that promised to move the plant into the modern age of metalworking. Managers hoped eventually to convert all of the plant's production lines to similar technology.

In December 1986, I walked through the line with a plant engineer who had spent the last four years trying to debug it. Although the line was operating, he explained that it seldom ran reliably at full capacity. And because engineers on the project had never found time to install and learn to use new measuring equipment, no one was sure whether quality had improved appreciably. Despairing, company managers decided to ship the production line off to a sister plant overseas. Soon after, they closed the Alton factory.

While somewhat extreme, this case illustrates a serious failing of industry: U.S. companies—and many of their counterparts worldwide—still have not learned how to introduce and exploit advanced production technologies to become competitive in global markets. Manufacturing managers often buy the most advanced equipment and systems but then fail to integrate them fully into production. Unsolved problems can persist for years, hindering quality improvement, product delivery, and factory efficiency.

The main reason for such difficulties is that managers do not fully understand the tasks involved in bringing new technology into the plant. In-

troducing new manufacturing technology is not simply a question of implementing well-developed solutions. Once new equipment has been installed, continuing efforts are needed to identify, diagnose, and address problems—and opportunities—that emerge only once the technology is on line. Companies must invariably modify both their existing systems and the new technology to integrate the advanced equipment, define its role, and exploit its novel capabilities. The problems they encounter are often unfamiliar, requiring users to develop new methods of investigation or to rely on untried sources of expertise. In the process, many existing routines must be unlearned.

To integrate new technology into day-to-day operations, an organization must respond to two conflicting sets of demands. Solving problems that arise from a new process frequently requires assumptions and behavior that differ radically from traditional approaches to managing production: a company needs to invest time and money in developing, trying, and evaluating alternative solutions. Yet ongoing operations require applying routines predictably, efficiently, and accurately. Too often, routine wins the battle. Managers insist that the advanced manufacturing lab or the equipment vendor take responsibility for ensuring that new machinery lives up to expectations.

Unfortunately, manufacturing issues cannot be resolved independently of production. In a recent study of automated assembly robots, fellow Sloan School professor Eric von Hippel and I found that some 80 percent of the changes made after a plant installed a new system proved necessary because the developers could not foresee all the realities of the factory environment. Likewise, in *The Sources of Innovation* (1982), von Hippel showed that in industries as diverse as scientific instruments and strip-steel production, the parties best positioned to identify and solve problems with new technologies are the users themselves.

To implement new technology successfully, plants need to schedule time for testing and experimentation just as diligently as they would schedule time for production. They need to create what I call “forums

for change”—to set aside times and places in which users and experts can gather and reflect on data, formulate new questions, and develop new solutions without disrupting normal production.

I base this conclusion on a field study I conducted at eight plants and four development labs in the United States, West Germany, and Italy, all operated by a major global producer of precision metal components. The corporation is one of Europe’s most consistently successful manufacturers: in the last 10 years, it has decisively bested a Japanese challenge in Europe and the United States, expanded operations in Asia and Eastern Europe, and maintained worldwide dominance in both market share and reputation for quality.

I examined 48 projects where the plants installed new processes, ranging from minor changes (such as a molding machine similar to equipment already in place) to radical departures from existing manufacturing processes (such as a microprocessor-controlled integrated assembly line). What I discovered was that where managers set up forums for change, they saved months of start-up time—and the resulting processes were both more reliable and more efficient.

Time and Space

While forums for change vary in kind, they all tend to provide four key conditions:

- ☐ Enough physical or cognitive distance from normal operations to offer a temporary haven from their most restrictive influences.
- ☐ Enough proximity to production operations to allow participants to probe a machine’s unique requirements and to observe how it will work in its intended context.
- ☐ Enough new people and new perspectives to provoke a fresh way of viewing the technology.
- ☐ Enough continuity among people to link problem solving and production.

A particularly successful forum for change was devised at an Italian plant that introduced programmable robots into its traditional finishing and assembly line. The robotics equipment was set up close to where it would later be installed, but for two months it was separated from the line by half-height plywood partitions. This space, which plant personnel called the “development box,” sheltered the project team from normal production pressures while the team ran trials, examined mistakes, and conceived new solutions. One of the innovative ideas that emerged from the development box was a new group called “pronto intervento.” This

Managers often buy the most advanced equipment but fail to integrate it fully into production. Problems can persist for years.

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was a small team of technicians who would be stationed on the plant floor, ready to respond immediately to problems spotted by operators on the line.

A long-term "resident" of the development box was the project leader, an expert operator and machine setter who had been trained in robot technology and who had helped design and select the system. Inside the development box, the project leader studied and adapted the equipment and software as the robot ran a simulated production sequence. At first, he collaborated with technicians from the equipment vendors to work out bugs in the hardware and configuration of the robot as they emerged. Then he enlisted the help of specialists in the plant technical office and the production supervisor on the line to develop new ideas or test new sequences.

In working with production and maintenance personnel, the project leader realized that the robot cell, the company's first experiment with flexible production, would require "a whole new philosophy, or new mentality, of production." To encourage this realization among prospective users, he brought them into the development box to watch and experiment with the machine themselves.

The development box offered several benefits. First, the project team could formulate solutions in close proximity to production. This was important because it enabled team members to test their ideas with production personnel. People and information could move freely between the production line, the development box, and the engineering office. Also, because the robot cell was brought into the plant two months before it was to be installed on the production line, project members had a chance to modify both the new technology and the existing production system without the pressures of daily quotas. They could try out ideas without disrupting production and thus could repeat experiments rapidly and relatively cheaply.

Indeed, project members explicitly tried to ferret out problems—something that would not have been in their interests if they were subject to normal production targets. They attempted complicated routines as soon as possible, for instance, and ran the robot cell at high speeds for long periods to investigate possible failure patterns.

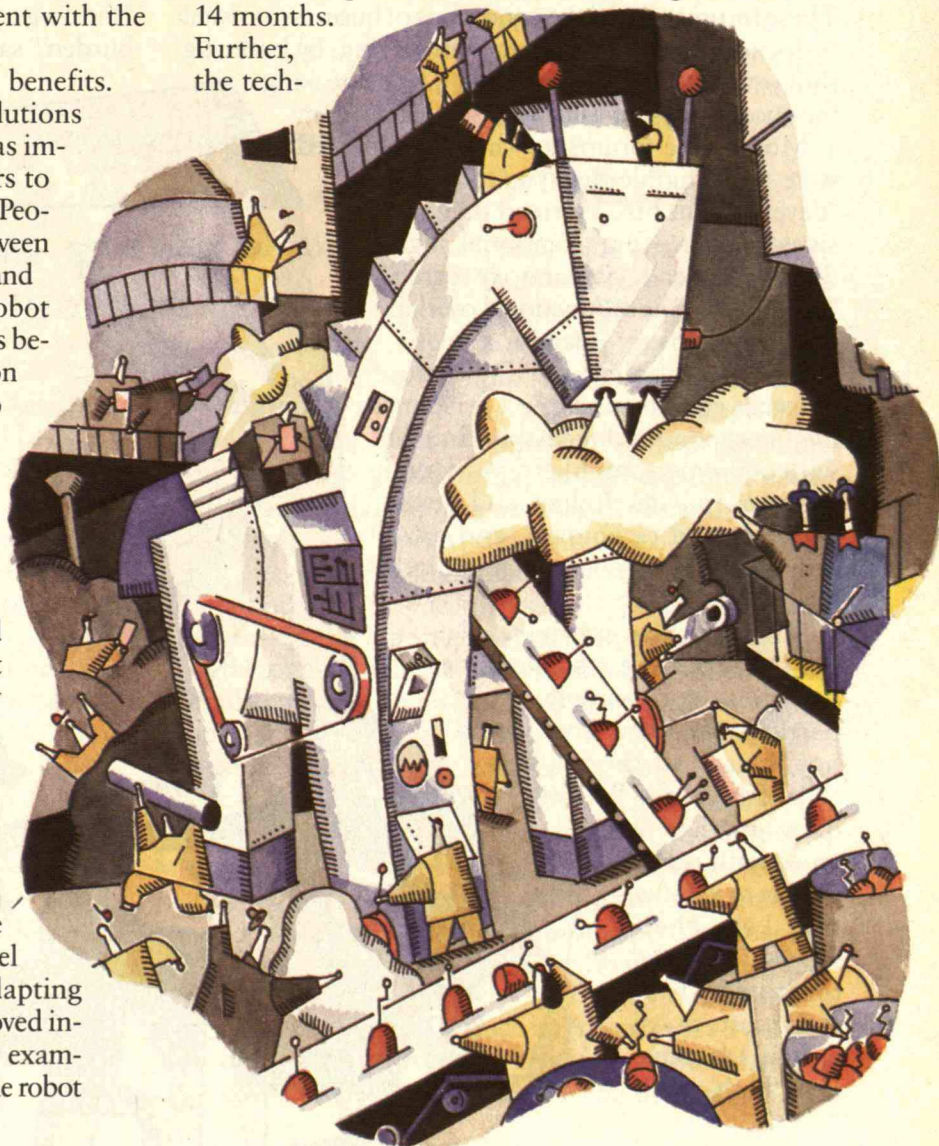
The development box was also a place where outside experts and plant personnel could collaborate on the difficult job of adapting the equipment to the plant. Often, this proved invaluable to both parties. At one point, for example, a manufacturing engineer noticed that the robot

was placing parts into feeder trays at an angle. Puzzled, she asked the robot vendor's engineer why this might be happening. At first, he said such an occurrence was impossible. But when the two engineers got together in the development box, they traced the problem to an unusual part configuration and the robot programmer's way of dealing with it. Finding the solution required at least two crucial ingredients: the shared perspective of the vendor and the user, and the opportunity to experiment.

Finally, the development box was a powerful asset because it brought together both technical and operating personnel from within the plant. This not only enabled those most closely involved in day-to-day functioning of the equipment to participate in technical decision making but also forced technical personnel to consider the actual needs and constraints of the production line.

Once the robot went on line, the start-up time was one of the shortest recorded: it took only 2 months to reach full production, versus an average of over 14 months.

Further, the tech-



nology's performance was outstanding. "Once we put the new cell into regular operation," said the department manager, "we discovered lots of ways to improve the process. But because of what we had learned already, putting improvements in place did not require any major changes." New operating and maintenance procedures were already in place. When operators needed help, they knew who to call and how to describe their problems. And technicians already had a clear sense of operating requirements on the plant floor. These things did not have to be worked out in real time.

Ingredients of Success

Erecting plywood partitions is not the only way to create temporary forums for learning about new process technologies. Other successful teams in the study established forums that, like the development box, were both closely linked to the production process and sufficiently separated from it to escape the rigors of production. These forums altered the conditions of business as usual by focusing attention on problem solving, by lowering the costs of trying new ideas, and by decreasing the uncertainty associated with solving problems.

Most of the forums for change I observed were less tangible than the robot cell's "development box." Instead they consisted of three organizational ingredients that I call "preparatory search," "joint search," and "functional overlap."

In preparatory search, a plant invests in problem solving before it installs equipment. Project personnel might negotiate technical specifications with equipment suppliers, work with suppliers on developing and testing concepts and techniques, and create systems and components to support the new technology.

When an Italian factory was planning to introduce a sophisticated drill press, for example, project participants knew they could not foresee all the implications of the change. But they drew on their experience with other presses to identify the key challenges. They determined that their most critical task was to create new high-precision

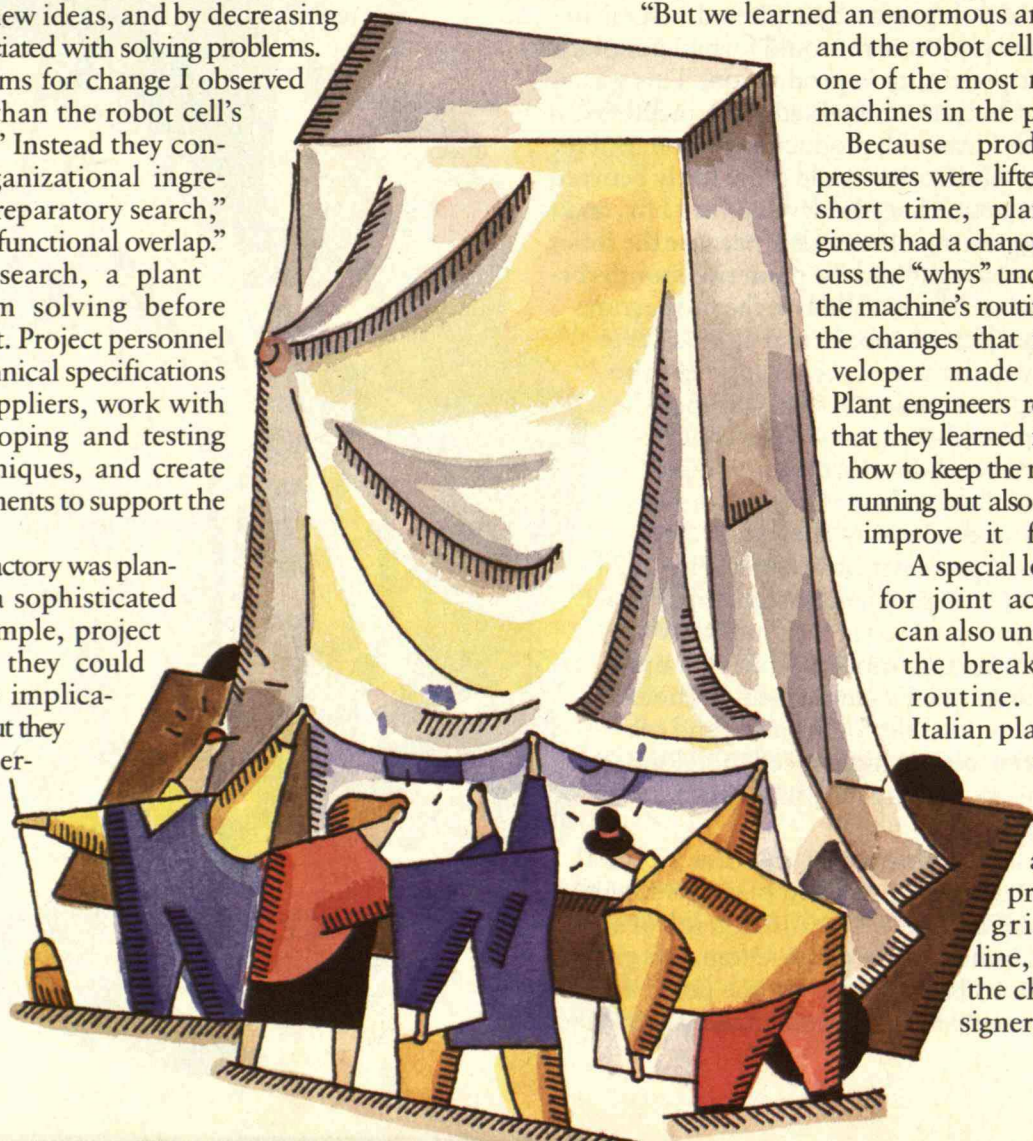
tooling systems. Accordingly, a small group of tooling engineers and technicians started designing new tools even before the equipment was ordered. While the machine itself was being built, the equipment vendor advised the group on what sort of interface they needed to construct between his computer controls and the tools they were developing. The tool study took over a year to complete, but it was not subject to normal time pressures because the equipment itself was still being developed. And the results benefited not only the new press but existing machines as well.

The second ingredient, joint search, involves using outside technical experts to help solve problems during the actual start-up of a process. Because outsiders are available only temporarily, their participation signals a change from business as usual. At a plant in Germany, an advanced robot cell built overseas was failing to perform reliably or precisely. The developer set aside a week to visit the plant on condition that the plant schedule no production on the cell during that time. "Finding a way to free up the cell for a week was a real burden," said the plant technician in charge of the cell.

"But we learned an enormous amount, and the robot cell is now one of the most reliable machines in the plant."

Because production pressures were lifted for a short time, plant engineers had a chance to discuss the "whys" underlying the machine's routines and the changes that the developer made to it. Plant engineers reported that they learned not just how to keep the machine running but also how to improve it further.

A special location for joint activities can also underline the break from routine. In an Italian plant that was installing a high-precision grinding line, one of the chief designers of the



equipment insisted before visiting the factory that the project group set up a small off-line facility for team meetings to review production data and test results. In other successful cases, plant personnel visited outside labs or production facilities to discuss problems.

Like preparatory searches, these working partnerships provide opportunities for trying new ideas in a protected, low-risk environment. In many cases, relationships with outsiders give plant personnel access to pilot lines or specialized testing facilities that could not be replicated in the plant. Links to outside experts enabled users to try out ideas through discussion and "mental simulation" before investing time and resources in actual changes.

Functional overlap, the third ingredient of successful forums, entails merging the roles of a plant's technical and production personnel. In one major project, an Italian plant pioneered a new metal-forming technology, the "United" process. For this factory, which had relied on traditional metal-removal processes, the United process was a fundamentally new approach to producing precision metal components. Accordingly, plant management emphasized the need to build technical skills through hands-on experience and to create closer links between technical personnel and plant operations. On each shift, a process engineer, a maintenance engineer, and an experienced senior operator formed a crew that shared responsibility for production. As the department manager explained, "The graduate engineers wore the overalls and ran the parts."

Thus, production personnel had ready access to technical input, while process engineers were never far removed from production realities. "It was important to get the opinion of each person in the group," said the project manager. "Each had an input into the final decision, but the final decision could not have come from any one person."

Besides breaking down barriers between traditional roles, arrangements like this one enable people to step back from the new production line and examine their experience. Each member of the production crew, for example, kept a daily log of irregularities. Once a week the entire project group—including the department manager, technical specialists, and production team members—met to investigate problems. "We used the logs to look back over days or weeks of production," explained one project engineer. "When we noticed a specific pattern of events, that's how we traced a lot of problems to their source."

Finally, bringing together multiple perspectives within a plant can spawn new ways of looking at problems. This occurred at a U.S. plant that introduced a novel integrated thermal treatment process. "On day one," said a project participant, "each person on this project brought a specific area of expertise. But there was a lot of cross-training and cross-learning. On day 100, every person was an expert in the system."

All three approaches help create forums for change by making it possible to explore technology in many small, reversible steps instead of a few giant blind leaps. A member of a U.S. team that had collaborated with the vendor in introducing a milling center commented, "Working together, we were able to do a great deal of mental testing of the ideas from both sides." With technical experts working close to the line, project managers are less fearful of trying new routines or running experimental tooling. Operators are reassured that small errors are not likely to destroy complex machinery, and production managers are less apt to assume that on-line testing will hamper their ability to deliver parts at the end of the day.


The Payoff

Forums for change do more than ease fears among those introducing manufacturing technologies. They also produce tangible benefits. For each project, I measured the elapsed time from installing

new equipment to completing the introduction process. I also gauged the improvements achieved with the new technology in reliability, efficiency, and other areas. Finally, I asked project leaders and participants to rate the amount of preparatory search, joint search, and functional overlap they had used in each project.

I discovered that each of these three ingredients contributed greatly to a project's success. First, they significantly shortened start-up times. Start-ups at plants that relied heavily on preparatory search, for instance, were almost four months shorter than at plants that did not. Doing a great deal of joint search saved two months. In fact, projects that used all three approaches extensively saved an average of seven months in start-up time.

The three approaches also boosted performance improvement. Projects that aggressively employed preparatory search, joint search, and functional overlap together reaped performance improvements 70 percent greater than the average for all projects. Indeed, heavy use of preparatory search alone accounted for a 35 per-



Bringing together multiple perspectives within a plant can spawn new ways of looking at problems.

cent increase, and high use of joint search led to a 20 percent increase.


The evidence even suggests that a failure to create forums for change may contribute to the relatively poor performance of some U.S. plants in introducing technology. MIT economist Lester Thurow and others have noted that American manufacturers are slower than European and Japanese ones in adopting processes that can make better products more cheaply. On average, the three U.S. plants in this study took almost 40 percent longer to introduce a process than the five European plants. And performance improvements were almost 50 percent greater in Europe than in the United States.

These differences turned out to be more than vague national tendencies. They depended largely on how

vigorously project groups in each country pursued forums for change. If the European and the U.S. plants had used identical levels of preparatory search, joint search, and functional overlap, the gap in start-up time would have been only about 10 percent; the gap in performance improvement would have been halved, to just 25 percent.

Establishing forums for change is not always easy. Preparatory search, joint search, and functional overlap all entail costs in the short term and concerted managerial guidance in the long run. This is because they require the time and attention of

both operators and technical support staff. They also demand cooperation across traditional organizational boundaries—boundaries that can be broken down only through long-term changes in career paths, train-



Even a highly skilled and motivated workforce cannot guarantee that advanced manufacturing technologies will be introduced smoothly.

How Innovation Conflicts with Production

WHY are special measures like “forums for change” necessary for introducing new production equipment? Without them, the problem solving required in any factory-floor innovation constantly clashes with a plant’s need to meet production goals. The result: slow start-ups and inefficient use of the new machinery.

Six sources of conflict are particularly salient. They can be illustrated by the difficulties encountered in a single, important aspect of technology introduction: the development of “tooling”—the drill bits, grinding wheels, and other attachments with which a new machining line must be outfitted to make specific products.

Direct and Indirect Costs: Developing and refining the tools for a new process incurs costs in designing, fabricating or purchasing, and setting the tool on the machine. Testing imposes additional but hard-to-predict costs by forcing operators or machine setters to modify their routines, disrupt-

ing regular production. And if a test fails—no matter how instructive the results—costs are incurred in the form of increased scrap, confusion at dependent operations, and missed or late orders.

Opportunity Costs: Problem solving competes with production for precious resources. Every hour spent on developing a new tool, for instance, represents a lost opportunity to use that time for other tasks. In the case of new tools, studying, drafting, fabricating, and testing a design can tie up process engineers, tool designers, tool-shop personnel, and other technicians. Conversely, the demands of regular production can pull technicians away from work on new tools.

In my study of process innovations at U.S. and European factories, I met a German plant engineer who had struggled with the introduction of a high-precision microprocessor-controlled turning lathe. He complained, “All the burden fell on us at once: to produce parts, work with oper-

ators, prepare new tools, see to maintenance, design new machine components, and have new ideas. But once we got the equipment into the factory, time to do important engineering work was squeezed out by everyday work to keep things running. The result was lots of lost time and gray hair.”

Slow Response Time: Established production practices often exaggerate both the direct and the opportunity costs by increasing the time required to respond to problems. A number of common practices can contribute. These include not enough technical support personnel, slow machine setup because of poor coordination or layout, chaotic demands on key production personnel, and poor facilities for collecting and analyzing data. Such conditions prompted one production supervisor to complain, “It was chaos around here the whole time we were trying to develop a tooling package for the new system. First, every new setup took about half a day—multiply that times two for

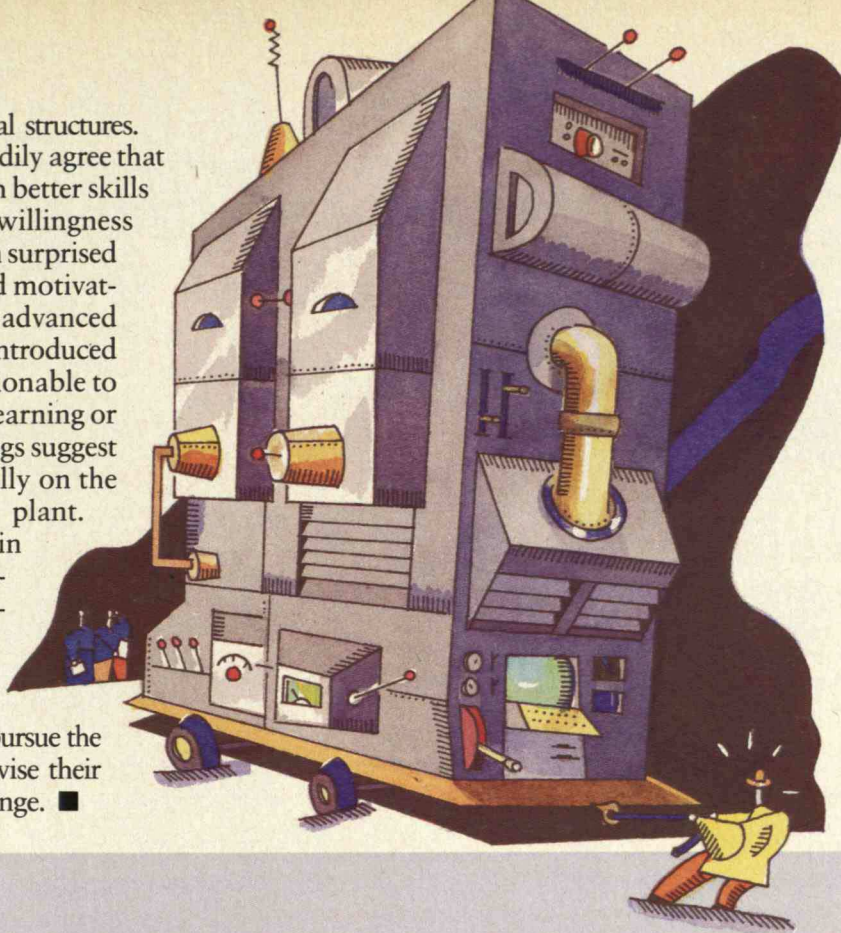
each tool test. Then, every time we ordered a new tool, it arrived with some defect or problem. Since the tool shop is halfway across the plant from the testing lab, I spent most of my time for nine months running from one place to another.”

Staffing and scheduling choices can add to the slow response time. For instance, while production often goes on around the clock, technical support is generally available on only one shift. In short, plants are often managed as if testing, experimentation, and problem solving did not matter.

Uncertain Payoffs: Although the benefits of experimentation and problem solving may be substantial, they are neither immediate nor predictable. In many cases, managers discontinue problem solving because it has achieved no obvious improvements within a set time. And they are often reluctant to experiment with improvements to a new technology after putting it into production. One project I

ing, reward systems, and organizational structures.

Most managers I have talked to readily agree that they need to work on developing both better skills throughout their plants and greater willingness to share those skills. But they are often surprised to hear that even a highly skilled and motivated workforce cannot guarantee that advanced manufacturing technologies will be introduced smoothly. While it has become fashionable to acknowledge the need for constant learning or "continuous improvement," my findings suggest that learning does not occur naturally on the factory floor, even in a well-run plant. Engaging production personnel in genuine problem solving means allowing them to step back temporarily from the pressures of regular production. In the future, success in using advanced technologies will go to those companies that vigorously pursue the approaches outlined here and also devise their own ways of building forums for change. ■



studied was aimed at developing the ability to grind all five "faces" of a complex part in one operation. But once factory personnel started using the new machine to produce a simpler part, further changes were difficult. As the production manager explained, "The focus immediately shifted to utilizing the machine as it was. We never did complete work on the full-face capability . . . because I could not justify taking the machine out of production when we could not be sure whether we would be successful." The cost of this decision may have been significant, but it was never measured.

Inappropriate Technical Resources: Trouble-shooting new technologies often requires expertise—say, in electronics, software, and systems integration—that is not available in the factory. But normal production routines can make it difficult to develop new skills internally or tap external sources of expertise. For instance, while the insight needed to understand a particular

problem might be available in a sister plant, production schedules, travel budgets, and internal competition may prevent the sharing of ideas. Similarly, while diagnosing a complex plant problem may require merging different perspectives and skills, the problem may be assigned to a specific group of "experts" in an isolated laboratory.

Cognitive Demands: Finally, problem solving and production conflict because humans can process only so much information. Which aspects of our environment gain our attention is determined largely by routine. Yet effective problem solving often requires focusing on unfamiliar variables, or measuring familiar variables differently, or interpreting production results in a new light. In many cases, underlying systems do not change even though procedures for recording, communicating, and analyzing production information are no longer applicable.

A plant in Germany, for instance, installed a new

computer-controlled machining line expressly to boost product quality. Ironically, the factory's budgeting and quality-control procedures prevented technicians from refining tools on the line once the finished parts met minimum requirements for quality. Technicians complained, but no one thought to question the validity of the procedures themselves.

Everyday pressures also discourage managers and technicians from seeking out or even recognizing information that might refute existing assumptions. When another German plant in my study introduced an advanced high-precision grinding cell, engineers assumed that the machine was technically sound and would require only minor modifications to produce excellent results. They had carefully tested the machine before buying it, and had agreed on its basic internal configuration. The result was that when the problems arose, the introduction team had trouble revising their assumptions.

Said an engineer who had worked on the project, "We wasted a huge amount of time fixing problems on the plant floor instead of attacking the real issues at the level of the [machine's internal structure]. We would make some small adjustment, but then, due to difficulties at a more basic level, something else would happen such as a tool or spindle breaking. Then we would waste more time fixing that, or waiting for it to be fixed. The whole process accomplished very little until we were able to rethink some of the early choices and assumptions."

For two and a half years, the new cell continued to produce at one-third to one-half capacity. It was finally redesigned only when a crisis arose, and developers and users were forced to work together to reconsider the internal structural problems. Once they broke away from the assumption that their earlier tests had to be valid, the project team was able to radically improve the cell's performance. ■

Scalpel! Clamp! Floppy Disk!

BY ROBERT W. MANN

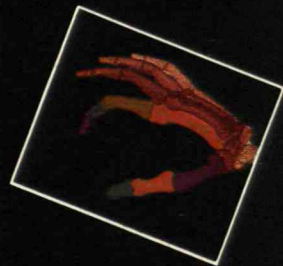
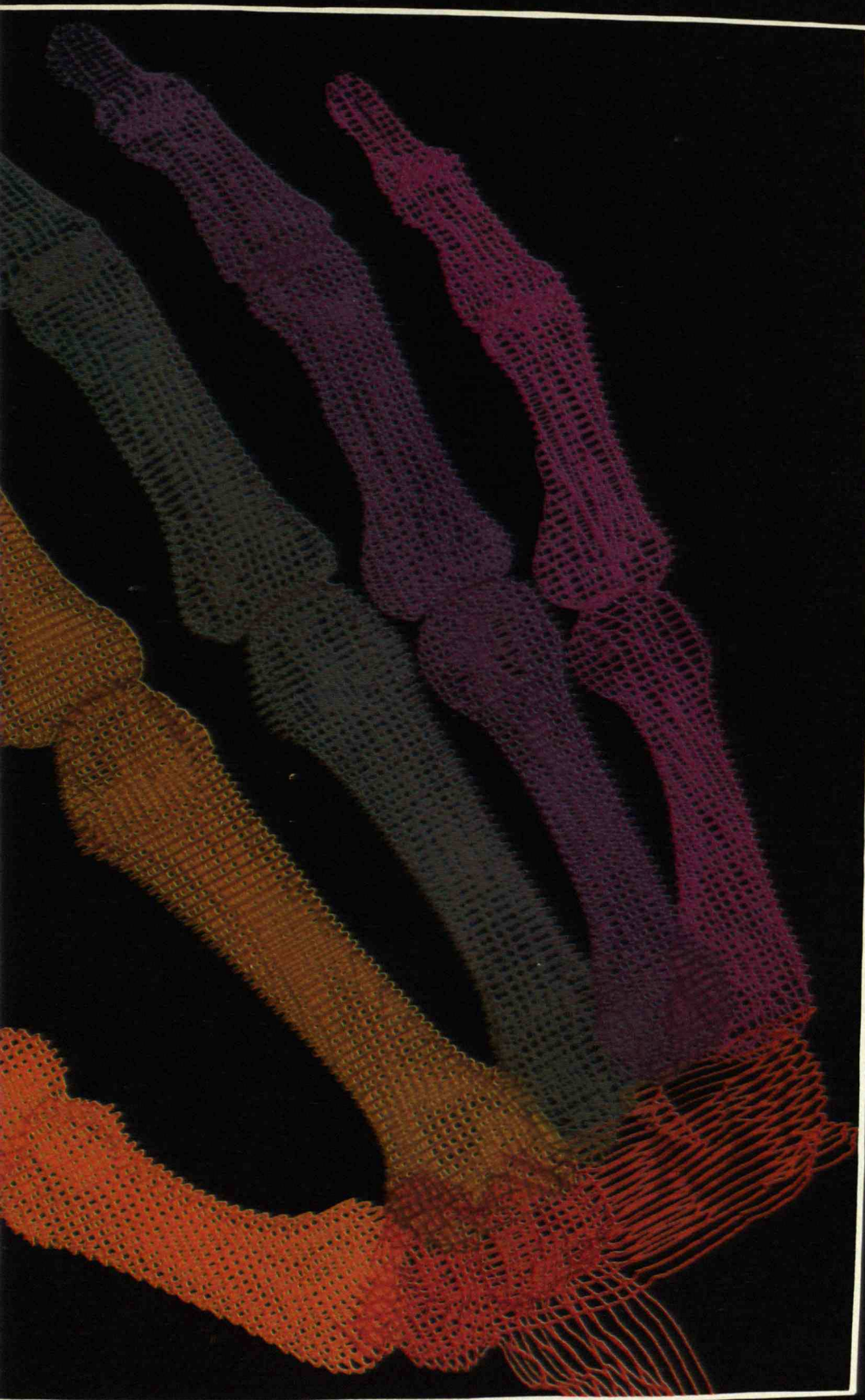
*With computer-aided surgery,
doctors can practice operations
until they get them right.*

A surgeon is like an engineer—not one who designs something new but one who fixes something broken. Of course, what is repaired is not a thing but a person—and therein lies the rub. Finding the best solution to a problem can be a tough assignment while a patient is on the operating table.

Therefore doctors have to learn as much as possible about a situation and evaluate various approaches before operating. Since the human body obscures its innards, the medical field has come up with several noninvasive ways to determine what is really going on. X-rays, the first solution, are blurry, since they superimpose on one image all the tissues through which the penetrating rays pass. Two-dimensional cross sections of the body produced by computer tomography and magnetic resonance imaging help. But when there's a problem in, say, a complex of bones, three-dimensional representation is invaluable. Fortunately, the technology involved in computer-aided surgery (CAS)—software that assembles 2D slices into 3D images that doctors can view from any perspective—is helping to better plan surgery and radiation therapy.

Today CAS is enabling doctors to simulate actual surgical procedures and practice how best to cut without fear of harming a patient. For a brain tumor, a radiologist can use computer-stored geometry of a patient's brain to plan how to concentrate the destructive radiation on the tumor, sparing nearby organs. A surgeon can practice facial, muscle, or bone procedures with





PHOTOS: WILLIAM L. BUFORD, JR., LOYD M. MYERS, DAVID E. THOMPSON/BRAND BIOMECHANICS LAB

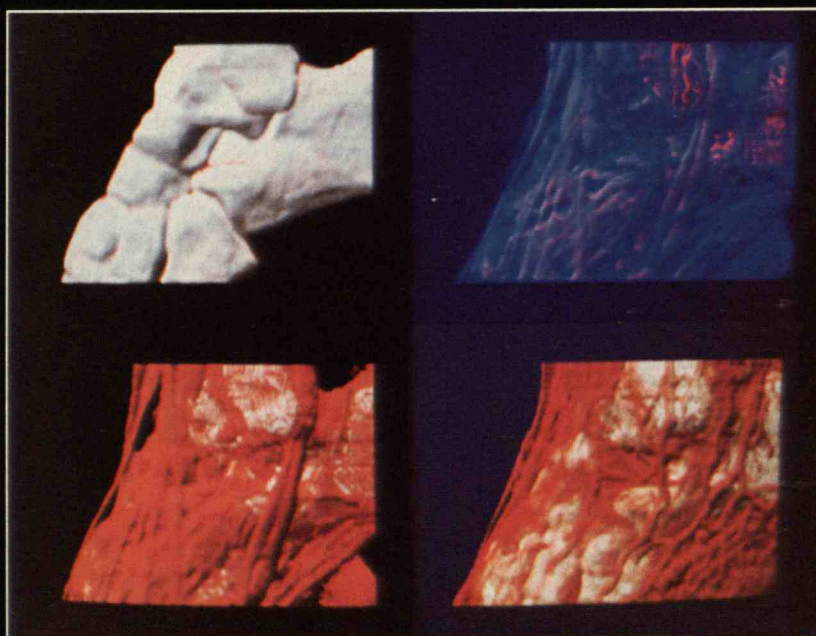
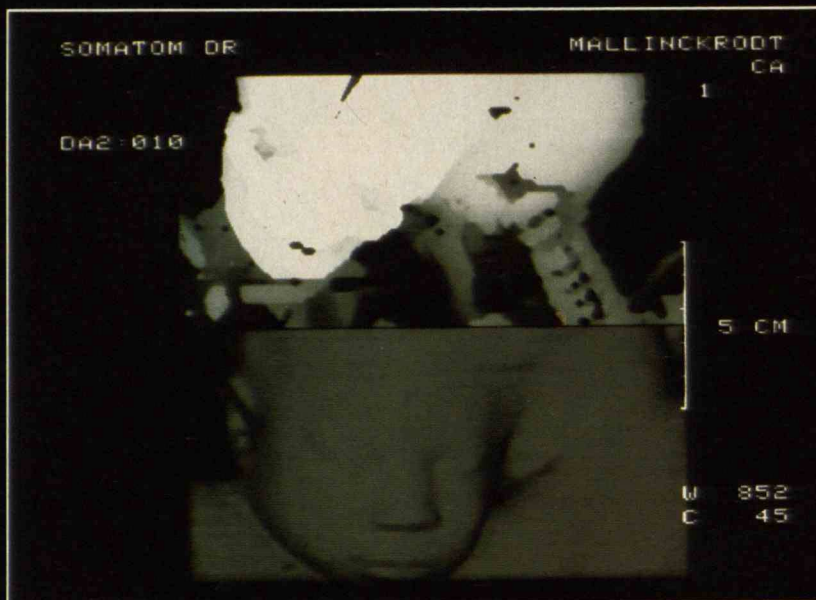
a computer model that incorporates the material properties of skin, muscles, and veins.

CAS inherits much from computer-aided design but is more complicated. After all, the human body is more complex than any engineered product, and each person's anatomy differs. Images must also be relatively lifelike, a difficult task. And the closer the simulation procedure mimics the doctor's usual techniques, the better.

How useful is CAS? In two studies of CAS use conducted by Elliot K. Fishman, a radiologist at the Johns Hopkins Hospital, doctors using computer-aided surgery changed their minds some 30 to 50 percent of the time about whether to operate or what tools or techniques to try.

As computers get more powerful—producing higher-resolution graphics faster—doctors will soon be able to view video-like images simulating the motion of, say, a joint or a limb before and after surgery. Future advances will incorporate expert systems to guide physicians through their decision-making process. Computers will be able to present doctors with preferred options based on what has proved effective in earlier simulations. And by the end of this decade, computers should be able to transfer information from their databases to operating rooms, where robotic jigs will locate precise places for incisions and guide cuts and the placement of body parts. The ultimate simulation will be “virtual reality”—a computer environment in which a surgeon will not only see but “touch” and “feel” as if actually performing surgery. ■

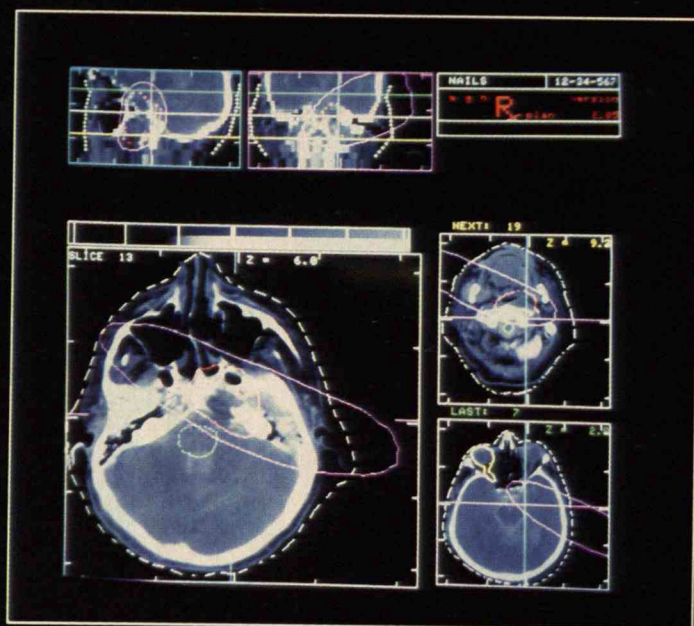
ROBERT W. MANN, Whitaker Professor of Bioengineering at MIT, directs graduate student research at the Institute's Newman Laboratory for Biomechanics and Human Rehabilitation.



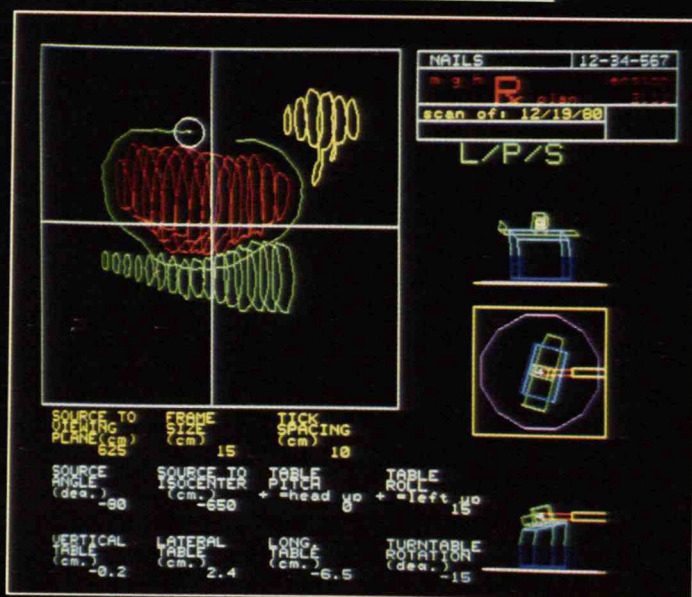
The oldest form of computer-aided surgery (CAS), now used widely, gives doctors better views of body tissues before they operate. 1: Software combined multiple two-dimensional computer tomography (CT) images to produce these pictures of Siamese twins. Surgeons in St. Louis used the images to plan the children's separation, which was successful. 2: The same form of

CAS helps surgeons pinpoint fractures within complexes of bones, as in this group that forms the ankle. A doctor can instruct the computer to “disassemble” the bones to identify the one with the break. This lessens the need to separate the bones in the operating room. The technology also shows overlays of soft tissue, particularly blood vessels and muscles.

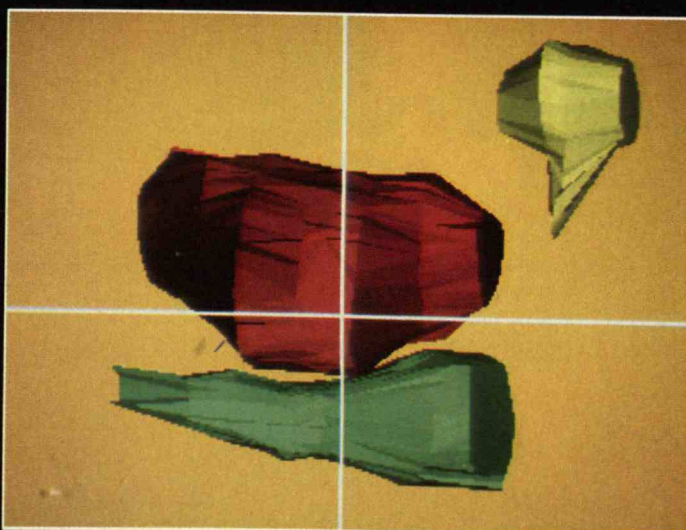
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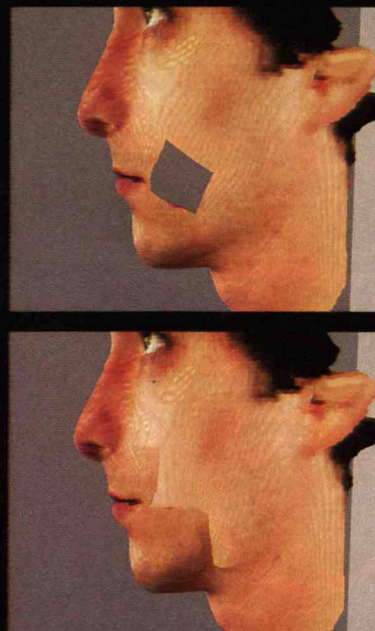
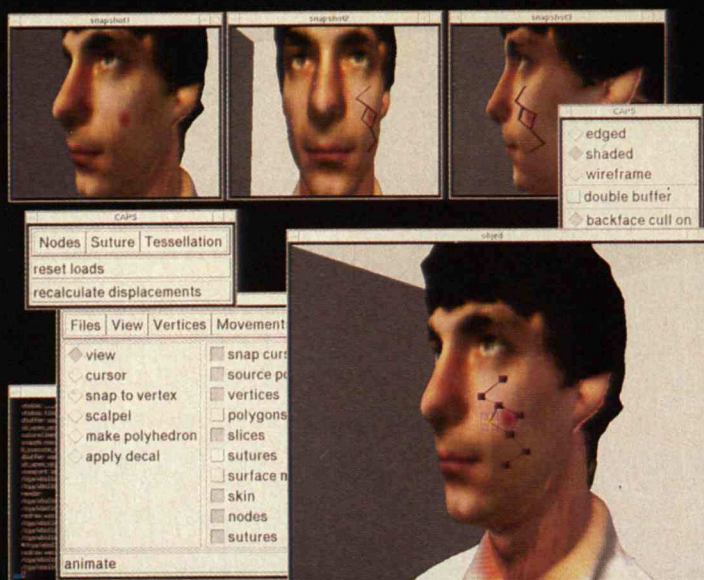
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Using a more sophisticated form of CAS, doctors can plan how to concentrate radiation on a brain tumor. A compiled series of CT scans provides a comprehensive database on the patient's brain (3). A physician identifies organs that must be protected, which in this partial profile of a head (4, upper left) are the brain stem (green) and eye (yellow). The tumor is shown in orange. The doctor can experiment with moving the table on which the patient is lying (blue, right) relative to a beam of radiation (orange), so as to concentrate the radiation on the brain tumor. The computer can also show three-dimensional views of the organs' relative positions (5).



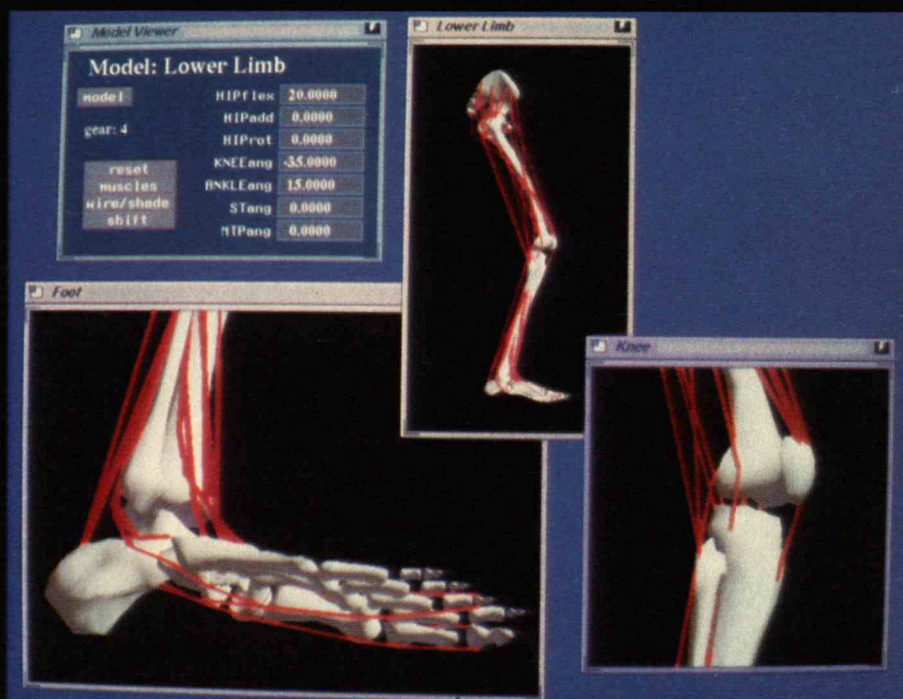
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CAS is also starting to enable doctors to simulate surgery involving soft tissues. In an MIT research model (6), the computer simulates a facial tumor. To plan its removal by plastic surgery, a doctor would first "paint" the needed incisions. Computer code would then model the mechanical properties of the skin and underlying muscles to show the effects of stretching the skin. The computer would "cut" and "close" the wound (7,8) so the doctor could see how the skin color matches at the seams. Finally, the doctor would "tweak" the facial muscles to check the smile.

To correct abnormal posture and gait in children with cerebral palsy, orthopedic surgeons change some muscle lengths by moving tendons that attach muscles to bone. But this alters muscular forces on the skeleton. Using a Stanford University CAS model of a leg showing muscles' lines of action in red (9), the surgeon can evaluate the effect of alternative operations.

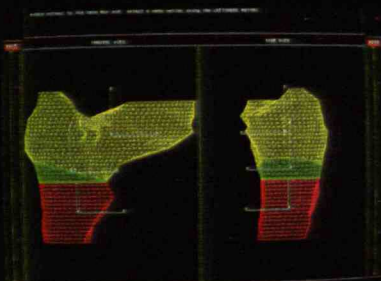


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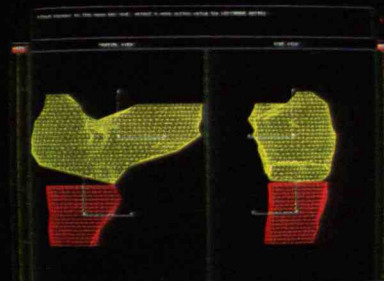
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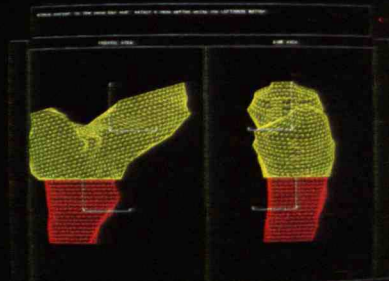
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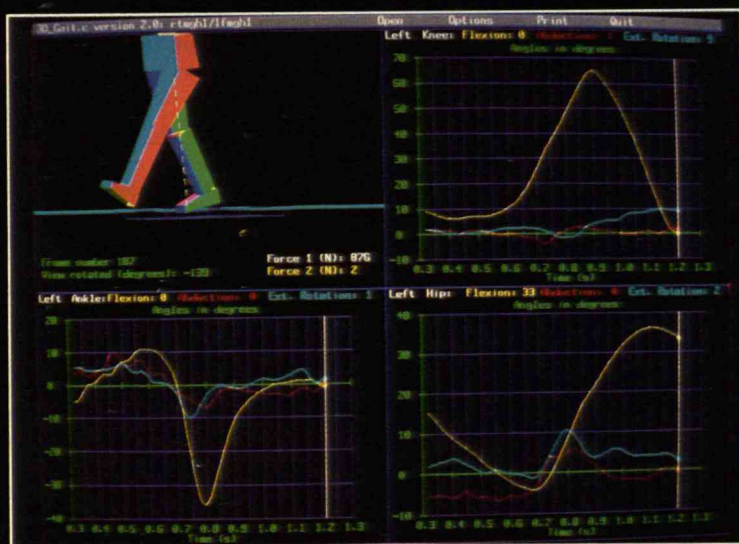
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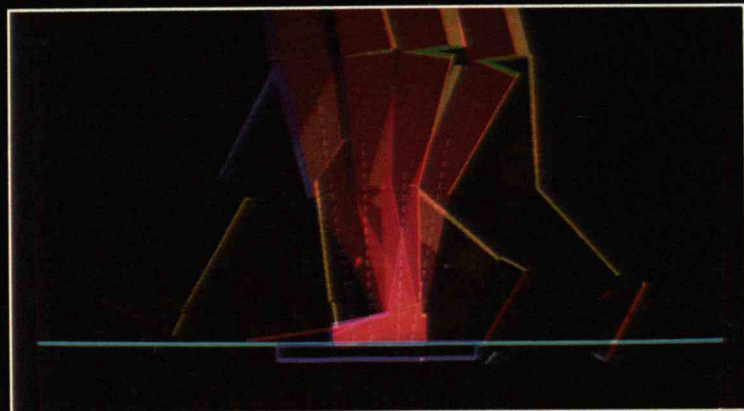
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Most doctors today alleviate arthritis in the hip by replacing the whole joint with a metal-plastic device. A more conservative approach spares the actual joint. In this case, the orthopedic surgeon cuts out a piece of the bone so that the part with good cartilage bears the hip's load. (10) Using a CAS program being developed by the author (right) and Derek Rowell, MIT associate professor of mechanical engineering, a surgeon can click a mouse to cut, slide, and rotate reconstructed CT images of a person's thighbone, and reassemble the pieces (11-13). Since the final goal is greater mobility, computer animation will let the doctor see the effect of different changes on the patient's range of motion (14,15).

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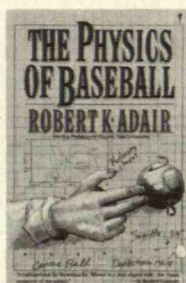
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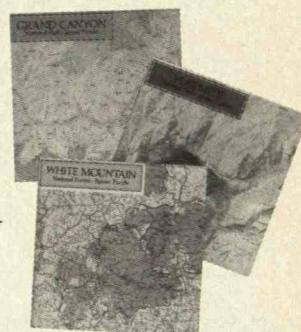
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Fighting Mother Nature

LIKE many troubled citizens of the world, I've been thinking a lot about nature lately. Threats of global warming, ozone depletion, deforestation, and species extinction have tempered my engineer's zest for progress.

Then a fierce cyclone attacks Bangladesh in May, and my mood changes. That catastrophe, which killed tens of thousands of people and left millions homeless, left me feeling betrayed as well as saddened. Just as I am cultivating compassion toward the environment, I am confronted with a violent reality that I had momentarily forgotten.

Scarcely had the images of Bangladeshi corpses faded from the news when a volcano erupted in Japan, killing 37 people and threatening 45,000 inhabitants of the city of Shimabara. In 1792, Shimabara was swept into the sea when a tidal wave followed a volcanic eruption, and the residents now fear a similar cataclysm. Televised pictures of the seething lava evoked a fervent communal response among the Japanese. For all their nation's technological and economic strength, many Japanese believe that they live on a fragile island, ever on the verge of disaster. As if to emphasize the precarious nature of life on earth, an even more lethal volcano—this one in the Philippines—erupted in mid-June.

Even worse than such periodic catastrophes are the continuing afflictions of drought, famine, and plague. In Africa, 29 million people face starvation. A woman in the Sudan tells a reporter, "There was no rain this year, so nothing grew." It is as brutally simple as that. In Latin America, cholera threatens to infect 6 million people, 40,000 of whom might die. And in New York City, where I live, the scourge of AIDS runs wild—evidence that no island is immune from calamity.

As I reflect upon this litany of woe, I can only conclude that nature is, if not malevolent, then certainly pitiless. My benign sentiments seem misplaced. Is not nature an enemy? Must not human

beings—engineers first of all—fight this foe for the sake of survival? Perhaps seventeenth-century philosopher John Locke had it right when he said, "The negation of nature is the way to happiness."

My mind races for engineering solutions to the disasters that beset us. We are not presently able to divert cyclones or protect the lowlands of Bangladesh from the raging seas. But we have made spectacular advances in forecasting the weather—using satellites and computers—and in being able to communicate our findings over radio and television. Lives can be saved through evacuation systems tied to early warning; also by construction of raised storm-proof sanctuaries. Airplanes and helicopters are mechanized angels of mercy, and their deployment, along with properly prepared food and medical supplies, should be central to international disaster

sending food from where it is plentiful to where it is scarce. In the African catastrophe, the difficulties are as much political as technical; ships, planes, and trucks are waiting to be used.

The conquest of disease demands research and more research. In the case of cholera, the disease can be averted by reducing water pollution. But the World Health Organization estimates that in Latin America this would cost \$50 billion over the next decade. In the meantime, an effective vaccine remains elusive.

If humanity is to endure, we must resist the onslaughts of nature with all our vigor and ingenuity. The war against nature must be unremitting. War, of course, is not the right word. If we use nature's blind hostility to justify all-out combat, we will further debase the environment and add to our perils. On the other hand, people and money that



ter planning. For the long run, earthquake-resistant structural design is a well-advanced specialty that may show the way toward coping with seemingly irresistible natural forces. The application of suitable building codes, however, requires political discipline and economic resources that are daunting to contemplate.

Even famine can yield to technology. The world has enough food, and agronomists are developing ever hardier plants, including strains that thrive with little water. Eventually, we will turn salt water into fresh cheaply enough to grow crops almost anywhere. At the moment, the problem is distribution,

are allocated to protecting the wilderness and purifying the environment are unavailable to build storm shelters, tame rivers, and study volcanoes.

In the end, the view of nature as enemy is no more acceptable than that of nature as friend. As Pliny the Elder wrote in his *Natural History* almost two millennia ago, "It is far from easy to determine whether she has proved to man a kind parent or a merciless stepmother." ■

SAMUEL C. FLORMAN, a civil engineer, is the author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, and The Civilized Engineer.

Industrial Policy Redux

SHOULD government care that U.S. companies are practically invisible in the global competition over the new generation of flat-screen computer displays? Will private enterprise develop more efficient automobiles, alternative fuels, and cleaner power plants—without public-sector funding? How can we get advanced manufacturing technologies into the hands of smaller companies whose survival may ultimately depend on innovations that they are now ill-equipped to use? With the Cold War over, should we refocus our highly regarded national laboratories on to civilian technologies?

During the 1980s, free-market conservatives and jaded Democratic Party economists thought they had discredited the idea that government should have a stronger hand in setting the nation's "industrial policy." It became conventional wisdom that government can't pick winners and losers. But the debate over industrial policy has revived, both in Washington and in corporate boardrooms. This time the bumper sticker reads, "Restore U.S. competitiveness."

The reasons why manufacturing is crucial to a healthy economy haven't changed. First, on average, each new dollar spent on manufacturing creates more than twice as much additional output as does each new dollar of spending on services. According to the Congressional Office of Technology Assessment, this multiplier effect has been growing in manufacturing industries while in the service sector it has remained flat.

Second, for all the attention being paid to R&D, much technological innovation takes place during the everyday process of *making* things. The idea that such incremental innovation may be a key to competitiveness becomes clear on a visit to almost any Japanese factory. A country needs an ample stock of this generation's factories if it is to nurture the next.

Third, skill development, like innovation, often takes place on the shop floor. If society loses its workplaces, it will lose its source of skilled craft workers. Academic institutions are no substitute for

the sort of national apprenticeship system that the Germans value so highly.

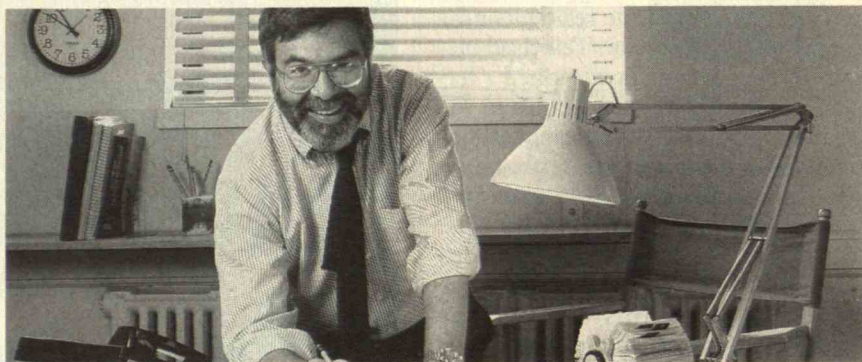
Fourth, manufacturing pays consistently higher wages than services. What's more, inequality among wage earners is lower, the proportion of very low-wage jobs is smaller, and—at least in the United States—benefits are more extensive.

Fifth, for manufacturing processes characterized by economies of scale, market advantage may depend on firms attaining "critical mass" before their foreign competitors do. Public policy aimed at getting domestic companies up to speed therefore makes sense even from the perspective of orthodox economic theory.

The old dichotomy between "sunrise" and "sunset" industries was never very helpful to policymakers, and we now have a clearer understanding of why. Basic manufacturing industries are a major supplier to high tech (computers,

"foreign" are becoming more and more intricate. It is the recognition that these complexities may overwhelm a *laissez-faire*, decentralized economy that is reviving the debate over the government's role in industry.

Over the next year, this column will examine the resurgent interest in industrial policy. We will see how, in a series of conferences, some of the country's leading economists are rethinking the question of why "manufacturing matters." We will peek at the findings of a series of papers commissioned by the blue-ribbon Council on Competitiveness, an industry-labor organization that is seriously attempting to find out why U.S. managers have such self-destructively short time horizons. I will present new information on the Japanese superiority in putting new technology into the hands of small and medium-sized enterprises. And we shall see how an unusual



for instance, have steel cabinets), and so-called "mature" industries, such as automobiles and steel, depend on advanced technology to raise product quality and manufacturing efficiency; where would the automakers be today without computer chips for their engines and robots for their factories?

Similarly the intellectually clever notion of a "post-industrial society" was always misleading. Like its foreign competitors, the United States is becoming an increasingly complex *industrial* society. The linkages between the manufacturing and non-manufacturing sectors, between high-tech and low-tech, and between what is "domestic" and what is

coalition of military and civilian planners, working through the Joint Economic Committee of Congress, is fashioning new legislation to bring home some lessons from abroad on how to get technology transfer right.

The underlying problems that gave rise to the earlier industrial policy debates are still with us. Ironically, this time around the private sector seems to be leading the way. ■

BENNETT HARRISON is professor of political economy in the school of urban and public affairs at Carnegie-Mellon University. His most recent book, coauthored with Barry Bluestone, is The Great U-Turn (Basic Books, 1988).

Reviews

BOOKS

WHY LET REALITY WRECK YOUR DAY?

Artificial Reality II
Myron W. Krueger
Addison-Wesley, \$29.95

BY G. PASCAL ZACHARY

THE computer has gone Hollywood. No longer just a super-calculator, it is now an image-generating machine of enormous flexibility, an endless source of fantasy. Having freed people from mental drudgery, the computer stands ready to erase the boundaries of physical existence, too. Why endure the rigors of travel, argues a burgeoning school of computer theorists, when you can experience the sights, sounds, and smells of Paris from your La-Z-Boy recliner? Curious about the inner life of lobsters? Join them on the ocean floor. Disappointed with your philosophy professor? Conjure up Plato and discuss his dialogues with him.

To the uninitiated, the claims of the computer cognoscenti smack of hubris. Are people to deny the limits of their own flesh, choose a silicon "cyberspace" over old-fashioned terra firma? But on second look, the choice seems less outlandish. Having conquered rationality, perhaps it was inevitable that the computer's next frontier would be reality itself.

This new digital realm is known as artificial reality, the subject of Myron W. Krueger's insightful, provocative, and funny book. Krueger, an artist and computer researcher, coined the term in the 1970s, when he began intensive studies in the new discipline. He wrote his first book on the subject in 1983, and *Artificial Reality II* is a much anticipated sequel that explores Krueger's journey in the trenches of this glitzy



field. The starting point for his investigations—and still his pet concept—is something called Videoplace, where one's body is seemingly projected into a computer-generated world of color and sound. It works like this: Stand before a video camera and your silhouette appears on a projection screen. An animated creature dances a jig on your head. Wave your hands and fresh colors appear. Move back and forth and your motions turn into music.

Krueger believes the experience of Videoplace is therapeutic. It is sort of an electronic "be-in," where people can shed their inhibitions and play. In Krueger's view, these experiences are akin to performance art. One such performance, which he calls Tickle, links people in two different Videoplaces electronically. "If a person in one environment touches the [image of the] person in the other environment with a finger, the computer responds with a sound—the more fingers, the more sounds," he writes in his new book. "Each person sounds different when touched. This interaction often becomes quite comical as people realize what is happening."

One point of this exercise is to achieve a kind of artificial proximity. "There is

a definite trend toward expanding the sense of being in the same place [as someone else]," Krueger writes. "We can see this trend in the development of transmission systems from Morse code to the telephone, to radio, to black-and-white television, and finally color television. Each of these . . . allows us to perceive events from afar more completely than does its predecessor."

Krueger's ideas have won him cult status among artists but little more. Air Force and NASA researchers, who have studied artificial reality for two decades themselves, have approached it differently, driven by a need to create realistic training experiences for pilots and astronauts. Rather than outfit a room with image-creating gear, they outfit an individual. A person wears lightweight gloves to manipulate objects within an imaginary, graphic world produced by powerful computers and delivered to the participant via tiny TV screens embedded in goggles or headgear. For added vividness, the person may wear a "data suit" that translates leg, torso, and arm motions into computerized images. The experience can be compelling. At Wright Patterson Air Force Base in Ohio, where pilots trained on early artificial reality systems, chief researcher Thomas Furness recalls that trainees would leave simulated cockpits "sweating, wrung out."

Though technically different, the "wear what is necessary" approach to artificial reality shares an important feature with Krueger's "come as you are" approach. Both allow the entire body to participate in, and ultimately control, a computer-generated experience. They share another trait as well, one that will bar artificial reality from most living rooms for some time to come: high cost. Experimental systems start at \$500,000, and even these can't produce images fast enough to fully convince gloved-and-goggled participants that they are actually crawling along an ocean floor in the guise of lobsters.

Nevertheless, big electronics companies are studying artificial reality, mainly because it could transform many

aspects of work and play. Sony reportedly is working on TV-quality goggles. In April, Matsushita's appliance unit opened a showroom in Tokyo outfitted with goggles and gloves so buyers of the company's custom-built kitchens can "experience" the possibilities before selecting one. Mattel, the U.S. toymaker, already offers an electronic glove that hooks into the Nintendo Entertainment System, enabling players to control video games with hand gestures. When the glove was introduced in late 1989, enthusiasts claimed it marked the dawning of a new age in computers, and the media fell in love with a technology that seemed straight out of *Star Trek: The Next Generation*.

In the ensuing torrent of reportage, Krueger, who works independently in

Vernon, Conn., was virtually ignored. This is unfortunate since Krueger has much of value to say about artificial reality, bringing a critical eye to a hyped field that he himself boasts could become "a medium as powerful as the printed word or television."

To start with, Krueger is honest about the technical shortcomings of today's artificial reality systems. He points out that systems combining goggles, gloves, and data suits are sluggish, cumbersome, and lacking in vividness because of fuzzy images and the absence of smells and touch. "It is surprising that people working with this technology are not more offended by this lag," Krueger observes. He adds that "if people have been unwilling to wear lightweight glasses for entertainment, it seems likely that a technology that asks people in everyday situations to don goggles, gloves, and wired suits to do their jobs will meet resistance." At the same time, he concedes that his own "come as you are" Videoplace system also lacks realism and is inherently expensive.

A Cornucopia of Uses

Convinced that the technology will improve and the cost will drop, Krueger looks forward to the day when the experience of artificial reality will be as commonplace as going to the movies or taking a walk in the woods. He envisions a cornucopia of uses, most of them in training and education. To learn French, you would no longer listen to tapes in a language lab but would "enter a graphic world and encounter a synthesized native speaker." Student drivers would not hit the roads before a workout on an artificial freeway. Sightseeing and shopping also could go artificial, with people in their homes immersing themselves in images of malls or exotic locales.

The technology could help physically disabled people as well, by translating "limited physical activity in the real world into full participation" in a simulated world. In other words, a quadriplegic might find joy in playing

artificial tennis with the body of Ivan Lendl. Krueger thinks emotionally troubled people would benefit from artificial reality too. Even psychopaths might live happily if permitted to avoid other people in digital dreams. "It may be realistic to define realities that adapt to the patients, rather than requiring everybody to adapt to the real world as we define it," he argues.

To Krueger, this seems only fair since he is acutely aware of how everyday life is constructed of the technological material at hand. "To an overwhelming degree," he writes, "our daily experiences take place in a reality of our own making. We live out lives in the automobile, the home, the office, and the shopping mall. Through the spoken word, the written word, and the television broadcast, we experience a conceptual world that is every bit as real to us as the physical world."

The point is well made: humanity's artifacts have severely limited our capacity to directly encounter the natural world. That "we are now proceeding toward immersion in a world created by the computer" is good news, Krueger thinks, because this computer-generated world—unlike, say, the flat, odorless world on the movie screen—will invite the full physical and mental involvement of the individual. It will bring about a more authentic collective experience.

Unfortunately, Krueger never makes a clear case why people will prefer computer-created places over the natural world, or even the old corner bar. The persistence of "back-to-nature" and environmental protection movements flies in the face of Krueger's implicit faith in the value of a future where the individual is ceaselessly surrounded by the glow of computer images. The hoopla over this promised revolution comes at a time when the future of the real world seems to be imperiled by looming ecological catastrophe. It would be ironic indeed if the effect of artificial reality was to erase the justifiable sense of loss people will feel over the demise of the forests, the rivers, the air, the planet.

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It is just this possibility that gives the prospect of artificial reality a bittersweet fragrance. If so directed, technology can help reverse the damage to our environment. But at bottom, Krueger and other promoters are inviting us to discard the physical world just when the going gets tough. ■

G. PASCAL ZACHARY is a San Francisco-based staff writer for The Wall Street Journal who covers computers and electronics.

BOOKS

BITTER PILLS FOR BIOPSYCHIATRISTS

Toxic Psychiatry

by Peter R. Breggin

St. Martin's Press, \$24.95

BY JAMES M. ELLISON

DURING a recent lecture to psychiatrists on advances in electroconvulsive therapy (ECT), the speaker invited comments from the audience. After several mundane questions, a woman who identified herself as a patient advocate occupied the microphone at length while she indicted ECT and its practitioners for flagrant abuses of human rights. She concluded her tirade by presenting the lecturer with a frying pan full of alleged brains before security guards escorted her from the room. After the lecture, audience members reacted to her accusations in a variety of ways. Some were outraged, others sympathetic, but none were surprised to see such a vehement opinion expressed about psychiatry and its methods of treatment.

For many years, the profession has turned its inquisitive gaze inward, focusing on questions such as the proper role of biological, or "somatic," therapies—mind-altering medications and ECT. In



Toxic Psychiatry, Peter R. Breggin addresses this issue in exhaustive and biased detail. While he raises many valid questions about the safety of modern treatment approaches, he blurs the evidence for their benefits and fails to acknowledge the richness of professional attention already directed to his concerns. The resulting lack of balance undermines the power of his critique.

Breggin, a psychiatrist well known for his attacks on psychosurgery, ECT, and psychotropic medications, worries that psychiatry has overemphasized the biological aspects of mental illness in a desperate attempt to repel the professional encroachments of mental health practitioners who are not physicians. He worries, too, that the pharmaceutical industry has purchased an uncritical endorsement from the profession. And he worries that doctors who have administered medications to hundreds of thousands of involuntary or uninformed patients have disregarded human rights on a massive scale. Above all, he worries that modern psychiatrists have eased patients' symptoms at the price of irreversible drug-induced brain damage instead of addressing their human conflicts within a caring psychotherapeutic relationship.

This destructive treatment, warns Breggin, is to be expected from medical-

ly oriented "radical biopsychiatrists," who view emotional turmoil as a manifestation of molecules gone awry. Such therapists, in Breggin's view, have but one mind-numbing trick up their sleeves: whether by means of medications, ECT, or the now rarely used technique of psychosurgery, the goal is to control behavior by inducing a "frontal lobe syndrome." This state is characterized by muted emotional experience, diminished capacity for abstraction or volition, and a reduced range of emotional expression. Through brain damage, Breggin argues, the biopsychiatrist also silences protest by dulling patients' awareness of the harm done to them, thereby producing a docile and compliant supporter of the psychiatric establishment.

But just as some psychiatrists may overemphasize organic causes of mental illness, Breggin errs in the opposite extreme. He points to an emotional state he calls "overwhelm" as the root of psychoses, mood disorders, anxiety disorders, and a variety of less common syndromes. Overwhelm, he suggests, occurs when an excessive and unmanageable passion, often a response to a tormenting environment, robs a person of internal control. Unbearable helplessness, guilt, or anger becomes transmuted into psychosis, depression, or anxiety. Breggin sees these conditions as opportunities for growth, as long as the sufferer is aided by an empathic helper and protected from somatic interventions. As evidence, Breggin draws on his experience with schizophrenic patients to offer moving anecdotes of psychotics abandoned in back wards who flourished when exposed to the curative power of a loving relationship.

Although many clinicians will applaud his emphasis on the therapeutic value of empathic and humane interactions with such individuals, most will view the dramatic rescues he cites as extraordinary instances. Few will agree that therapy for psychotics—especially schizophrenics—can routinely progress without judicious use of antipsychotic drugs.

The reason is that most research suggests that schizophrenia stems from the interaction of a biological predisposition with an individual's experiences. Over time, supportive verbal psychotherapy can certainly build upon the stabilizing effects of medications, helping people care for their basic survival needs and improve their social skills. It can also help patients confront the painful readjustments of identity that follow psychotic episodes. Yet psychotherapy cannot replace medications' ability to diminish the acute and agonizing symptoms that intermittently disrupt reality and make human contact intolerably frightening.

Nor are most clinicians as heedless of the neurological side effects of antipsychotic drugs as Breggin claims. Psychiatrists have recognized for years that

these medications can cause, among other side effects, apparent changes in brain function that may or may not be reversible. Although many patients, past and present, have been inadequately informed of the risks of treatment, current practice stresses informed consent and strategies for reducing a patient's drug intake. Studies show that using minimal effective doses or periodically suspending drug treatment is superior to abandoning medication. With either approach, the risk of more frequent relapses or hospitalizations is often balanced by greater vibrancy and social interactiveness in the patient. One drug, Clozaril (clozapine), benefits behavior without producing tardive dyskinesia, a disfiguring neurological disorder sometimes brought on by other antipsychotic medications. This offers the hope that future medications will be able to alleviate psychotic thinking without unwanted effects on the nervous system.

Breggin's sallies against somatic treatments are more credible when he discusses depression and mania, which lend themselves more readily to psychosocial explanations than do psychotic disorders. Although biological factors appear to play a role in many mood disturbances—and although somatic treatments have repeatedly proved effective in relieving depressive or manic symptoms—he rightly notes the importance of exploring psychological factors in depression before employing a chemical treatment.

As Breggin points out, tricyclic antidepressants (like Elavil) and monoamine oxidase inhibitors (like Nardil), mainstays in the treatment of depression for over three decades, routinely cause unpleasant physical side effects and can be lethal in overdose. Breggin also cautions against uncritical acceptance of the recently introduced "alternative antidepressants," such as Wellbutrin (bupropion) and Prozac (fluoxetine). Like earlier antidepressants, each of these medications can produce troublesome or dangerous side effects, some of which may have yet to be uncovered. In-

deed, few nonprofessionals and too few professionals are aware how little human testing the FDA requires before it will approve a new medication for public use.

Breggin's attack on another depression treatment—ECT, now undergoing a revival in many hospitals—is also justified to a point. Psychiatrists have abused ECT in the past, and some may still be lax in obtaining thorough informed consent. Moreover, neuropsychological research has confirmed that some individuals will not completely recover memories of the month or two surrounding ECT treatment. And for reasons unknown, some patients complain of more persistent or severe memory impairments.

But then Breggin goes overboard, calling on doctors to warn patients that ECT achieves its therapeutic effects by damaging the brain. A truly informed patient would need to know that this question remains open. Data supporting the argument that ECT produces brain damage are counterbalanced by at least equal evidence that brain damage does not occur, either as a side effect or as a therapeutic mechanism of convulsive therapy. In any event, many patients report lifesaving improvement as a result of ECT, especially when it is performed with minimal current and with modern refinements such as anesthesia, muscle paralysis to prevent contractions, and treatment of only one side of the head.

The same animosity Breggin displays in his discussions of disorders and treatments weakens his timely comments on modern psychiatry's intimate relationship with the "Psychopharmaceutical Complex." There is no question that psychiatry, like other branches of medicine, has become heavily dependent on pharmaceutical makers to subsidize many professional activities. Drug companies are the major advertisers in, and therefore supporters of, the professional journals. They also underwrite research projects, training fellowships, and educational events. Professional societies have called attention to the ethical dangers inherent when physicians ac-

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cept gifts from pharmaceutical manufacturers, and recently issued ethical guidelines recommend more stringent limits on such practices. Still, Breggin loses focus on this important issue when he strays into ad hominem attacks on specific researchers who have collaborated in various ways with pharmaceutical companies.

Despite such excesses, it's hard to fault Breggin on his basic conclusion—that psychotherapy and the self-help movement offer valuable help to those in emotional pain. Though little hard scientific evidence is available to support his position, the collective wisdom of the mental health professions certainly remains on his side. No psychiatric disturbance should be treated with medication or ECT alone. In schizophrenia, the need for family involvement and the usefulness of a rehabilitative focus are gaining recognition. In mood disorders such as depression and mania, cognitive and interpersonal psychotherapies have shown promise in relieving symptoms and reducing relapses. With many anxiety disorders, behavioral approaches appear to offer highly effective relief without the use of drugs.

As Breggin reminds us, a consumer of psychiatric services entrusts a caregiver with the treatment of his or her soul. A focus solely on "chemical imbalances" or biological treatment can disregard the immensely healing power of the psychotherapeutic treatment relationship. *Toxic Psychiatry*, because of its alarming and misleading wholesale condemnation of somatic therapies, will deter some readers from obtaining needed help. But perhaps it will also offer support to those who advocate combining a caring treatment relationship with an informed, carefully monitored use of somatic therapies. ■

JAMES M. ELLISON, MD, is an assistant professor of psychiatry at Harvard Medical School, chair of the psychiatry department at Heritage Hospital in Somerville, Mass., and a practicing psychiatrist. He edited *The Psychotherapist's Guide to Pharmacotherapy* (Year Book Medical Publishers, 1989).

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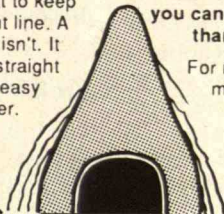
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Notes



Unstressed Pilots

Stress-control training for pilots might improve air safety. A study conducted by NASA's Ames Research Center, the U.S. Coast Guard, and U.S. Army researchers indicates that pilot error—a major factor in some airplane crashes—could be reduced if pilots learned “auto-genic feedback” to lower their level of stress.

As Patricia Cowings of NASA-Ames explains, “autonomous mode” behavior by pilots is one cause of crashes. In such cases, a pilot in a high state of psychological and physiological arousal tends to narrowly focus on a single problem. Often the pilot ignores more critical information and fails to carry out important crew-coordination activities.

Elders and Disease

Older people may be more susceptible to disease than young people because specific cells in their immune system fail. Keith Kelley, an immunologist at the University of Illinois College of Agriculture, says macrophages—cells that ingest bacteria and kill tumor cells—don't work right in older immune systems.

Normally, when a tumor or bacterial cell invades a body, cells called T-lymphocytes release gamma-Interferon to signal macrophages to attack the invader. But macrophages stay inactive in a weakened

immune system, even when Kelley bombards them with a genetically engineered version of gamma-Interferon.

Medical Shortage

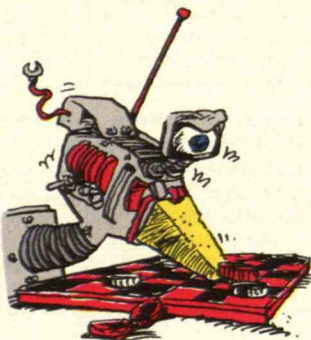
The health-care system is ill-prepared to cope with occupational and environmental illness. The annual cost of such diseases is an estimated \$6 billion, yet according to the Institute of Medicine (IOM), the United States has 3,100 to 5,500 too few physicians trained in these fields.

To correct the shortage, an IOM committee has made six recommendations, including integrating occupational and environmental medicine into medical school curricula. Another proposal is to establish 10 to 15 centers to train future teachers of these specialties.

Checkers Robot

Other computers can calculate checkers moves, but a robot at the University of Rochester is the first to move the pieces itself. The robot uses different parts of its brain to see the board, strategize, and direct its four-inch yellow foam nose to nudge the checkers.

“Our ultimate goal is not to build checkers-playing robots,” notes Rochester computer scientist Thomas LeBlanc, “but rather computer systems that do different kinds of tasks



simultaneously.” The robot's ability to combine divergent functions—vision, motion, voice, and reasoning—is a significant programming achievement that has many potential industrial applications.

Uncorroded Oysters

Proteins in oyster shells may help lower the \$100 billion annual corrosion bill in the United States, thinks Eric Mueller of the University of South Alabama Mineralization Center. Small pieces of these proteins—polypeptides—turn out to inhibit the scaling and corrosion common in chemical and manufacturing plants.

Researchers are learning to create the polypeptides synthetically and modify them to be more effective. “When bound to metal surfaces, these polypeptides, specifically polyaspartate (polyaspartic acid), resist both corrosion and mineral build-up,” Mueller told the American Chemical Society.

Better Bars

The ubiquitous bar code is changing. By late next year, that grid of lines and spaces on most everything we buy could look completely different, making it more versatile.

Today's bar codes are “one-dimensional”—a horizontal line of laser light reads vertical bars and spaces. If the symbol is damaged, the code is worthless, since the full pattern printed on merchandise is the key to retrieve information stored in a computer.

With two-dimensional codes, an array of vertical and horizontal dark and light squares actually contains the information—as much as 3,000 bits of it. And the code is durable—even if part of it is damaged, the rest can be read and its information extracted.



Micro-Velcro

Using techniques developed to make the components in integrated circuits, Carnegie Mellon researchers have invented two kinds of “Velcro” that might some day suture blood vessels, attach heart pacemakers, or connect minute electronic devices.

“These fasteners provide a way of joining extremely small mechanical objects without using adhesives,” says researcher Michael Reed. “Other advantages include imperviousness to extremes of temperature, humidity, and attacks by chemicals.”

Pesticide Reduction

Replacing half the chemical pesticides in U.S. agriculture with alternative pest-control practices would raise food prices less than 1 percent, a Cornell University study predicts. And while the cost to farmers and consumers would be about \$1 billion a year, the benefits would be even greater.

The analysis combines data from hundreds of researchers at university labs and government agencies. It covers 40 crops, from vegetables and fruits to cotton and tobacco, and it examines alternatives to popular chemical insecticides, herbicides, and fungicides.

Environmental benefits include less damage to wildlife, trees, and water supplies. Public-health benefits include reducing the hundreds of millions of dollars spent each year for victims of pesticide poisoning. Also, pesticide regulations would be easier to enforce.



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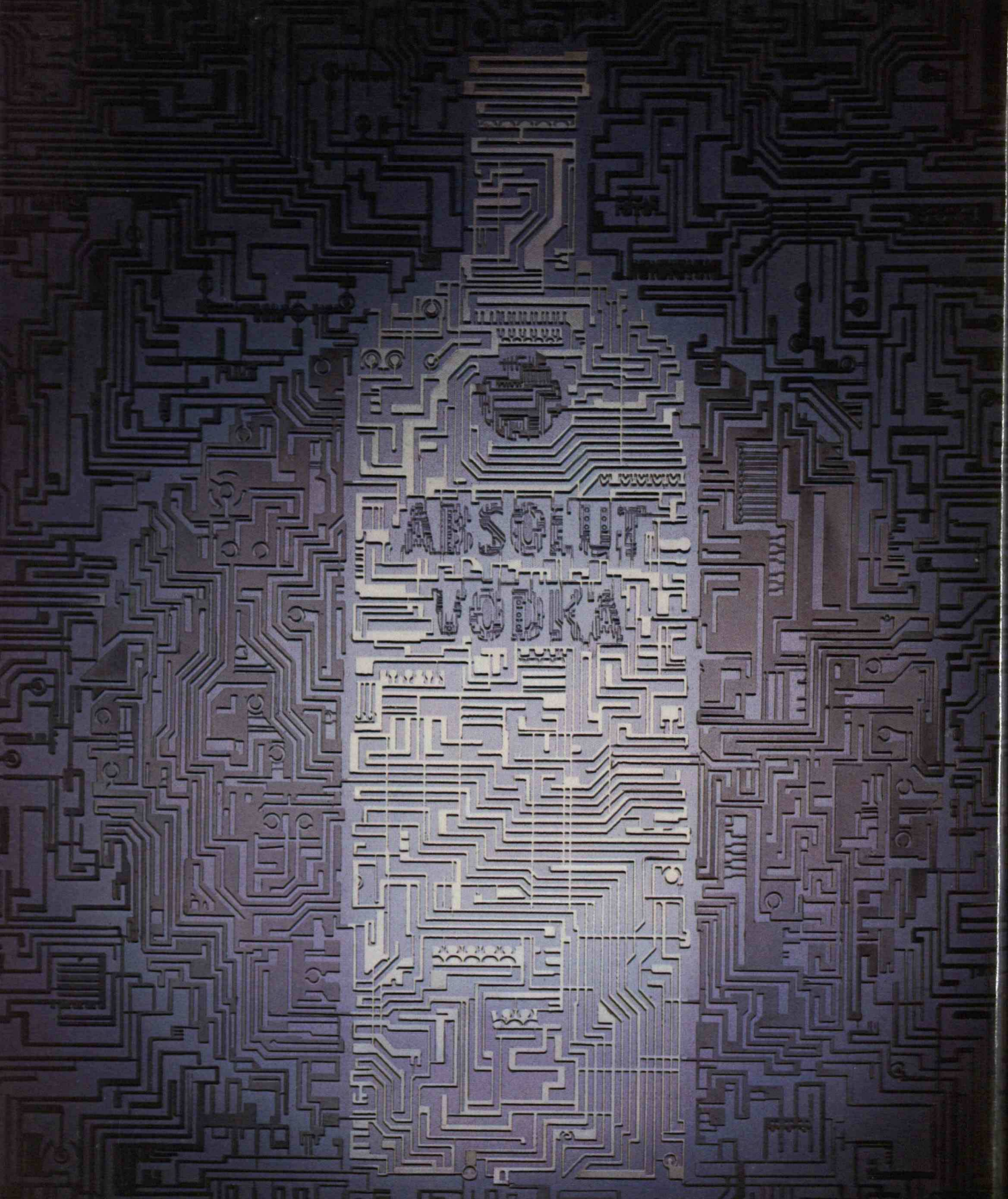
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